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CONCERNING MANURING.

AFTER Liebig had announced his famous theory of manuring in the middle of the nineteenth century, farmers in England generally believed that the low productivity of an infertile soil was solely due to the lack of some particular mineral element which could easily be supplied from an external source. It was the custom of agricultural chemists in those days to attempt to construct exact "balance sheets" based on bulk chemical analyses of soils and crops, and to prescribe from the deficit side of the balance sheet suitable manurial materials that would correct the soil's infertility. Although the procedure seemed convincing enough, actual experience and many failures showed that the inter-relation between soils and crops was not so simple as Liebig had supposed. Subsequent investigations into the rôle of nutrients in plant growth have slowly revealed the fact that, unless all other growth factors (such as water supply, air supply, absence of harmful agencies, including excessive acidity, or alkalinity, undesirable micro-organisms and plant toxins) are exerting their greatest effects, the mere addition of mineral manures may fail to produce good growth and better crops.

Many manurial treatments, prescribed even at the present day, take no account of the operation of factors other than the direct nutritional factor. Thus, the oft-discussed question of the relative value of organic manures (such as farmyard manure and green dressings) as opposed to artificial inorganic materials, is frequently considered in terms of the amounts of "plant-food" that each may contribute to a soil, whereas actually an apparent superiority of one over the other may be due mainly to its favourable effect on soil tilth, water supply, aeration, or some other soil property.

During the prosecution of manurial experiments, attempts ought therefore to be made to disentangle the various factors that contribute towards the success of any particular treatment, so that the relative importance of each factor may be accurately assessed. Frequently the agriculturist is quite satisfied merely to measure the effect of manurial treatments on total crop yield; he is seldom interested in the *reasons* for increased or diminished returns; yet, by the application of suitable experimental methods, these reasons may sometimes quite easily be elucidated, and the knowledge thus acquired may be used in the formulation of better manurial methods.

It may be conceded that the modern design and layout of manurial field experiments, based on much accumulated experience, and on recent rapid developments in methods of statistical analysis, is eminently satisfactory, and that, in the hands of competent specialists, the present technique may be trusted to yield results having a high degree of reliability. It certainly constitutes an enormous advance on the procedures in vogue but a decade ago, for it enables the practical man to select his own odds in favour of a particular treatment being quantitatively effective under a certain set of climatic conditions. Moreover, these results may be assessed in terms of monetary values; the statistical treatment of the data is merely the application of the mathematics of the laws of chance, and is entirely necessary in the study of the interplay of variable factors.

It would appear, then, that there is further need of a widening of the scope of modern manurial experiments, and a still greater need of caution in the interpretation of results obtained from them. In the first place, too little consideration is usually given to the selection of site. Above all else, the land chosen for a field manurial experiment with a particular crop should be typical of the area over which that crop is grown for profit. Unfortunately, we frequently find that an experiment station meant to serve a large area, is situated, often for reasons of economy, on land entirely untypical of the soil of the area as a whole, and presenting growth conditions exceptional in their controlling influences.

Secondly, too little attention is generally given to the inherent character, composition and physical properties of the soil itself; just as if, indeed, soil were an inert medium, constant and uniform in its behaviour, and functioning in no other way than a simple sand culture. That there are an unlimited number of kinds of soil seems often to be lost sight of altogether. Failure to appreciate this obvious fact has led to many grave mistakes in the selection of methods of manurial treatment. Manurial programmes that are specially suited, for instance, to the successful cultivation of sugar-canes in Hawaii may be entirely unsuitable when applied unmodified to the cane crop of Barbados or of Natal.

The soil is *not* an inert medium. When manures are added to it, profound chemical actions and interactions ensue. These may vary widely in nature and degree with different soils. Thus, the ferroginous, red laterite type of soil (such as occurs in West Africa, India, Java, Hawaii and many other humid tropical countries) is entirely different in physical and chemical behaviour from the siliceous soils developed under less humid cooler climates. Not only is lateritic soil naturally very porous and open, though retentive of moisture, but also its chemical properties are peculiar, in that the soil is capable of fixing relatively large amounts of phosphate, and perhaps even nitrate. The siliceous soils, on the other hand, fix very little phosphate and nitrate, but are capable of retaining greater amounts of potash. The growing plant absorbs only those substances that the soil can deliver in a suitable form to its roots; the nature and amount of these substances, as well as their availability, are only indirectly due to materials added as manure. It is therefore obviously inaccurate to speak of an ideal manurial mixture for a particular crop; one should speak rather of manuring a particular *soil* for a particular crop. Furthermore, not only do the total amounts of added manurial ingredients affect differently the nature and degree of interaction with the soil, but their actual proportionate amounts are also important. Recent research has stressed the significance of "balanced ratios" in soil nutrients delivered to plant roots, and has even indicated that different ratios are perhaps required at different stages in the plant's development. Thus, in the early stages, a preponderance of nitrogen and potash in most cases is required, whilst in later life, further additions of potash are less necessary. Even the nature of the other entities added along with manures such as potash seem to exert their specific influence. Thus experiments have indicated that potash supplied as muriate may produce somewhat different results from those obtained when sulphate of potash is employed.

The experimenter on manurial requirements requires to know many facts that have recently been demonstrated by the plant physiologist, if he would discover the very best way in which to produce maximum crops. There would appear to be no limit to the number of inter-related factors that must severally be experimentally examined in order to attain this object. Fortunately, the modern laboratory methods of soil examination furnish a means whereby the interactions of soils and added manurial substances may be traced. The periodic application of these methods to large-scale field experiments should enable the investigator to interpret the final results, and to formulate new and better treatments. Since generalisations in field practice are dangerous, the only rational procedure lies in the multiplication of field and laboratory experiments progressively planned so as to incorporate acquired knowledge in the designing of further trials. Thus, manurial investigations become more and more the duty and concern of specialists. At the most, the intensive crop grower can only be expected to apply the recommendations of the scientific investigator, and to provide facilities for his complicated experiments.

The development of manurial practice has furnished many instances of the importance of minor unexpected factors in soil fertility. Thus, there is some indication that the virtue ascribed to farmyard manure may lie in the stimulating effect afforded by its content of some unidentified organic accessory food substance ("auximone" nutrition), although some recent investigators of

the subject lay greater stress on the effect of small quantities of particular iron compounds that are apparently contained in organic manures. Doubtless many other accessory factors are essentially involved in plant nutrition; thus the peaty Everglade sugar-cane soils of Florida were found to respond remarkably to applications of small amounts of copper and manganese salts, and numerous other cases of infertility due to lack of manganese in soils have been recorded. Indeed, traces of compounds of several different metals (including molybdenum, zinc, nickel, chromium and even silver) have been suspected to possess important rôles in the phenomena of plant growth. A careful study of these accessory factors falls also to the lot of the modern manurial specialist, and, assuming that the crop grower sustains faith in his methods, there is no reason to doubt that agriculture will not become more and more intensified through the greater utilisation of his expert services.

BOOKS RECEIVED.

We acknowledge with thanks the receipt of the following books which have been presented to the Library :—

ECONOMICS.

Headlam, C.—The Milner Papers. Edited by C. Headlam. *Cassell & Co., Ltd. London* 1931. £1 10s. (Presented by the Rhodes Trust.)

AGRICULTURE.

Clarke, G. H., and Fletcher, J.—Farm Weeds of Canada. *Ministry of Agriculture*, Canada, 1906. (Presented by Professor Ballou.)

BOTANY.

Brandis, D.—Illustrations of the Forest Flora of North-West and Central India. *W. H. Allen & Co.*, London, 1874. (Presented by Professor Ballou.)

Stiles, W. and Leach W.—Respiration in Plants. *Methuen & Co. Ltd.*, London, 1932. 3s. 6d.

CHEMISTRY.

Appleton, E. V—Thermionic Vacuum Tubes and their Applications. *Methuen & Co., Ltd.*, London, 1932. 3s.

ENTOMOLOGY.

Brues, C., and Melander, A. L.—Classification of Insects. *Harvard College*, Cambridge, U.S.A., 1932. £1 5s. ($6).

Joy, N. H.—A Practical Handbook of British Beetles in Two Volumes. *H. F. & G. Witherby*, London, 1932. £3 3s.

TRINIDAD FUNGI.

Copies (price 2s. each) of a list of TRINIDAD FUNGI compiled by C. A. Thorold can now be obtained on application to the Editor of this Journal.

THE ARROWROOT LEAF ROLLER (*Calpodes ethlius*).

By F. W. Urich.

These notes are based on two visits to St. Vincent, the first, from the 3rd to the 17th August, 1931, and the second, from the 13th to the 22nd April, 1932. On both occasions, through the kindness of the Hon. F. A. Corea, and the assistance of Mr. J. M. P. Roberts, the writer was able to visit the more important arrowroot plantations.

The so-called "arrowroot worm" is a pest of long standing, and the damage it is capable of doing to the arrowroot crop does not seem to have been assessed, beyond noting the defoliation of the plants. Past records show that defoliation varies from year to year according to the occurrence of natural parasites of the eggs of the butterflies and of those of the caterpillars, as well as to weather conditions. Usually caterpillars are numerous at the beginning of the season following cropping (January to March), when there is an abundance of young leaves. At that time, few parasites are to be observed. As the season advances, and as the rains increase, the caterpillars are controlled by natural enemies, in that, towards the end of a planting season, comparatively few caterpillars are to be seen, but many of the leaves show marks of old damage.

On the occasion of the first visit in August, most of the fields bore signs of severe past damage, many plants having been stripped of all leaves, the remaining leaves being fully matured and hard. There were then comparatively few caterpillars, but much evidence of parasitism by natural enemies both of caterpillars and of eggs was observed. Rough field counts yielded the following results :—

Thirty per cent. of the caterpillars had been killed by undetermined Tachinid parasites; 25 per cent. of the eggs had been destroyed by *Trichogramma minutum;* and 3 per cent. of the caterpillars had been eliminated by a Eulophid parasite, *Elachertus meridionalis*. At the time of the August visit, egg parasites were predominant, but there were signs that the Tachinid parasites had been numerous.

The second examination of the fields was carried out in April, 1932, in order to note conditions after cropping, when the leaves were young. There is no regular reaping season for arrowroot in St. Vincent, but plantations endeavour to reap before the rains set in between the months of October and March. Fields show young leaves a month after reaping. This is a very vulnerable stage of growth, and the leaves are much attacked by caterpillars. Fields are often severely defoliated several times before the caterpillars are attacked by natural enemies.

Ovipositing butterflies seem to prefer young growth for their progeny, and often concentrate on individual fields. The predominance of one of the early stages of the butterfly seems to depend on the state of growth of the plants after cropping. A field which had been reaped in January showed a predominance of eggs in April. Many of the eggs showed exit holes of *Trichogramma* parasites, but a few young caterpillars were hatching in addition. In another district, a field which had been reaped five months previously, contained caterpillars of which the majority were fully grown and ready to pupate. An adjacent older field was less affected by caterpillars. In yet another district, a field of young growths was attacked and destroyed in patches. Here, eggs and recently hatched caterpillars were predominant. The incidence of *Trichogramma* was low in all these fields. Few Tachinid and few Eulophid parasites were observed during the April visit.

The Butterfly.

The insect responsible for the caterpillar pest of arrowroot in St. Vincent is the well-known skipper butterfly, *Calpodes ethlius*, Cram. This insect has been known since 1782. It has a very wide range of distribution, which extends from the South-Eastern States of North America to Mexico, Central America, and through South America to Argentina. It also occurs throughout the West Indies. Besides this wide distribution, *Calpodes* is a powerful flyer, and occasionally migrates long distances. The food plant of the caterpillar is principally *Canna* in most countries, and arrowroot wherever it is grown.

In most of the localities where *Calpodes* occurs, parasites of the eggs and caterpillars have been recorded, so that a choice of the most suitable species for purposes of natural control is indicated.

Life History Notes.

The development of the arrowroot butterfly occupies a period of roughly 22 days, distributed in various stages as follows:—

Egg stage ..	4 days.
First stage caterpillar ..	2 do.
Second do. do. ..	2 do.
Third do. do. ..	2 do.
Fourth do. do. ..	6 do.
Pupa ..	6 do.
Total	22 days

The period during which the adult female lives, and the number of eggs laid, have not yet been ascertained. Adding eight days and possibly longer for oviposition, it is highly probable that a new brood can be expected about once a month. Like many tropical insects, however, the broods overlap, and all four stages of the butterfly may be seen in a field, especially towards the end of the growing season. At the opening of a season when the plants are sprouting, the broods emerge more uniformly.

Habits of the Adults.

The butterflies are active during sunny days, when they visit flowers for purposes of feeding. In the early morning, they have been observed drinking water from dew or rain drops occurring on the leaves. Oviposition takes place principally in the late afternoon.

Habits of the Caterpillar.

As soon as a young caterpillar emerges from the egg, it consumes some of the egg shell, and then wanders to the margin of a leaf where it turns down and fastens by means of silken threads a small flap so as to form a shelter. As growth proceeds, new and larger shelters are formed by the caterpillar, pupation finally taking place in a securely fastened shelter, formed either of green or of withered leaf tissue. Owing to the difficulties of dusting or spraying with arsenicals for destroying caterpillars, biological control seems to be the most promising measure for eradicating the pest. If the parasites of St. Vincent are not able to exercise efficient control, then importations from Trinidad and other places might be tried.

Calpodes Parasites Recorded.

FROM TRINIDAD:	
Affecting Eggs	*Trichogramma minutum* (dark variety).
	Oencyrtus sp.
	Anastatus sp.
Affecting Caterpillars	*Apanteles talidicida*.
	Microbracon sp.
	Two undescribed *Elachertus meriodionalis*, Crawfd. Species of Tachinid.
Affecting Hyper-parasite of Apanteles.	*Spilochalcis* sp.
FROM ST. VINCENT:	
Affecting Eggs	*Trichogramma minutum* (dark variety), recorded by Harland.
Affecting Caterpillars	*Elachertus meridionalis*, Crawfd. (on third stage caterpillars). Two species of Tachinid flies reared from pupae, not yet determined. Harland records the following Tachinids, *Eucelatoria australis*, Townsend. *Sariodexia sternodontes*, Townsend.

ACKNOWLEDGMENT.

We acknowledge with thanks the receipt of three agricultural implements sent by Mr. R. L. Knight, a former Post Graduate student, now stationed in the Sudan. This is his second donation of this kind, and is much appreciated by the Professor of Agriculture, who will always be grateful for the receipt of any unusual indigenous agricultural implement or tool to add to his collection.

CITRUS EXPERIMENTS.

The Programme of Citrus Experiments of the Department of Agriculture, Trinidad.

By R. O. Williams.

Introduction.

In recent years, rapid strides have been made in northern countries in the development of methods of experimentation with annuals and orchard crops. On the other hand, only the scantiest information is available regarding the best lay-out of cultural and other experiments with orchard crops in the tropics. A detailed account of the experiments that are now being initiated at the St. Augustine Citrus Station may therefore prove of interest to those who are faced with the problem of planning similar work.

The culture of grapefruit as a commercial enterprise has been undertaken in Trinidad only within the last decade. The raising and distribution of plant material, and the giving of general advice regarding development of orchards, has been largely undertaken by the Department of Agriculture. During the course of this work, practical problems have arisen which have shown a need for field experiments. These include investigation regarding the best stock for general use; the best height for placing the bud upon the stock in view of the danger of infection by gummosis; the selection of stocks as regards types of roots, and the best and most profitable methods of cultivation and manuring. The experiments outlined in this paper have been planned to meet this need.

The Honourable E. J. Wortley, O.B.E., Director of Agriculture, initiated the preliminary organisation as regards site and funds, and instructed me to prepare a draft programme of experiments. In this work, I received much assistance from him, from Mr. S. M. Gilbert, B.Sc., and from Mr. P. E. Turner, M.Sc., of the Imperial College of Tropical Agriculture. The programme was then referred to the Field Experiments Sub-Committee appointed by the West Indian Conference of Agricultural Officers, 1930, and, as a result of suggestions made by Mr. D. D. Paterson, B.Sc., was slightly modified. Finally, the programme was submitted by Mr. Gilbert to authorities at East Malling, and at Rothamsted, and has received their approval.

Site and Environment.

Forty-three acres of land draining from north to south was chosen as the site for the Citrus Experiment Station. It is 57 feet above mean sea-level, with an average annual rainfall of 55.30 inches distributed over a 19-year period as follows:—

	Average for 19 years 1913-1931.
January	1.93
February	1.04
March	0.90
April	1.57
May	2.95
June	7.67
July	7.76
August	8.28
September	6.40
October	5.41
November	6.94
December	4.45
	55.30

The prevailing winds are from the north-east.

Soil.

The soil is a sandy-loam; sand content, 55 per cent., derived from deep river-alluvium brought down from the Northern Range quartz schists by the St. Joseph River. It is neutral to slightly acidic in reaction. The organic matter content is about one per cent. The sub-soil is similar, but somewhat more acidic in reaction. The area has been used for many years mainly for sugar-cane variety trials.

General Scope of Experiments.

The two main problems which the experiments have been planned to solve are:—

(1) The selection and preparation of suitable planting material for grapefruit and orange cultivation.
(2) The best orchard treatment for grapefruit.

(1) *Selection and preparation of planting material for grapefruit and orange cultivation.*
- (*a*) To test various kinds of Citrus as stocks for Grapefruit and Oranges, especially as regards
  - (i) general growth and habit,
  - (ii) yield and quality of fruit, and
  - (iii) resistance to disease.
- (*b*) A study of certain nursery methods, such as,
  - (i) height of insertion of bud on stock, and
  - (ii) comparison of straight and crooked tap-roots, and their relationship to the development of the tree.

(2) *Orchard treatment for grapefruit.*
- (*a*) To compare the effects of various cultural methods,
- (*b*) To compare the effects of applications of various combinations of artificial and organic manures.

Stocks used in the Experiments.

Four main groups were taken for experimentation, viz.: Sour Seville, Sweet Seville, Rough Lemon, and "Wild" Grapefruit. *Sour Seville* is the common sour orange of the West Indies. It has greenish-yellow, extremely acid pulp. *Sweet Seville* possesses orange-coloured pulp of pleasant though bitter flavour. *Rough Lemon* is the common warty-skinned lemon of the West Indies. *"Wild" Grapefruit* comprises seedling trees originating from an early introduction; they occur scattered amongst other cultivated trees. The fruits are usually oval, very seedy, and lacking in juice.

There is no data to indicate that any one parent tree within a stated group has any marked advantages over another, and the trees could therefore only be chosen at random.

Except in the case of the Rough Lemon, four parent trees of each are represented in the experiments. Rough Lemon is only represented by one parent tree, but when needed for comparison it is replicated four times.

The following are the names given to the chosen trees and the dates of sowing the seed:—

Group.	*Name of Tree.*	*Date of Sowing.*
	Barnardo 2	18th April, 1931.
Sour Seville	River 2	7th Feb., 1931.
	Govt. Farm 1	9th March, 1931.
	St. Clair 2	7th Feb., 1931.
	Curaçao	7th Feb., 1931.
Sweet Seville	Phillips	1st April, 1931.
	Rapier House Piece	1st April, 1931.
	Rapier Watch House	1st April, 1931.
Rough Lemon	River 9	7th Feb., 1931.
	River 18	1st Feb., 1931.
"Wild" Grapefruit	River 22 Upper	1st Feb., 1931.
	River 22 Lower	1st Feb., 1931.
	River 21	1st Feb., 1931.

Scions used in the Experiments.

In the selection of trees for furnishing scions for the experiments, advantage has been taken of a varietal experiment of grapefruit and oranges planted at St. Augustine in 1923. Quality of fruit as well as yield were taken into consideration in making the selection.

A record of the yields of the selected trees from the time that bearing commenced is given in Table I.

Nursery Methods.

Seeds of the stock plants were sown in drills in beds and the seedlings transplanted to other beds when a few inches high. A second transplanting to the budding beds was made during the period July-September, 1931. Approximately four times the required quantity of stocks were transplanted to allow for future selection for some uniformity of growth characters.

All plants were budded at a uniform height of ten inches from ground level, except where specifically stated in the experiment dealing with various budding heights, and the diameter of each stock was measured at the point of bud insertion when budding was performed. As far as growth of stocks allowed, at least twice the actual number of plants required for each experiment were budded for the purpose of selection for growth characters at the permanent planting.

Tree training for the purpose of forming the main framework of the tree consisted in training one shoot from the bud to a straight stake. When it reached a height of 30 inches from ground level, it was topped back to two feet from ground level, the aim being to get the plant to form three or four shoots arising from different nodes near the top. In practice, it was found that in some cases only one shoot formed, and the plant had to be cut back a second time to force it to make a sufficient number of shoots; in some cases there were more than the required number, and they had to be reduced.

TABLE I.—YIELDS OF TREES SELECTED FOR SCIONS.

Tree.	Date of Planting.	Number of Fruits.					Total for 5 years.
		1926-27.	1927-28.	1928-29.	1929-30.	1930-31.	
Marsh 91	Aug. 1923	88	81	479	473	484	1605
Marsh 108	do.	53	84	329	550	473	1489
Marsh 103	do.	12	124	355	364	551	1406
Duncan 127	do. ...	27	84	261	539	321	1232
Foster 110	do.	80	253	561	562	354	1810
Valencia 65	do.	2	33	330	869	362	1596
Jaffa 32	do.	11	122	657	1655	790	3235
Washington Navel St. Clair 3	1922			unknown.			
Pineapple St. Augustine	unknown....			unknown.			

Soil treatment in the nursery beds consisted in frequent hoeing for the control of weed growth, and one application of sulphate of ammonia at the rate of ½ oz. per stock plant applied on 9th to 10th October, 1931. Two sprayings with Bordeaux mixture were made in an effort to control scab, one on the 20th November, 1931, and the other on the 9th January, 1932.

Nursery Records.

Every seedling in the nursery has a serial number, and a book is kept in which all nursery operations likely to be of use are recorded. The serial number of a tree will then be its designation in the field and plot experimental records.

General Lay-out of Experiments.

The land is divided into three main blocks of 17¼, 12¾ and 13¼ acres respectively, with roads dividing and surrounding them. Main drains are provided by the roadsides.

The tree stations for the grapefruit experiments are spaced at 30 feet by 30 feet, and for the orange and stock experiments at 25 feet by 25 feet. A drain running east to west and connecting with the main drains is provided between each row of trees.

A row of *Tephrosia candida* has been sown mid-way between each row of trees in a north to south direction for the purpose of protecting the young trees from wind.

The Survey Department assisted with the lay-out by lining the whole area with a theodolite, and placing permanent pickets at distances of 120 feet apart each way.

General Soil Treatment.

Except where specifically laid down in Experiment V (cultural treatments) and Experiment VI (manurial treatments), the general soil treatment will be uniform, and on the following lines:—

Light fork or plough once annually. Hoe or harrow as required to control weed growth. Divide in three equal quantities and apply in May, August and November, artificial and organic manures in the following quantities:—

50 lb. pen manure	increasing	50 lb.	annually
½ lb. sulphate of ammonia	,,	½ lb.	,,
2 lb. superphosphate	,,	2 lb.	,,
½ lb. sulphate of potash	,,	½ lb.	,,

Hoe or harrow after each application.

Details of Experiments.

EXPERIMENT I.—STOCKS FOR GRAPEFRUIT.

Aim.—(*a*) To test the relative merits of Sour Seville, Sweet Seville, Rough Lemon, and "Wild" Grapefruit as stocks for grapefruit. (*b*) To test known parent trees in each group as stocks for grapefruit.

Stocks.—Seedlings from four parent trees of each kind of stock are used. *Scions.*—Marsh Grapefruit, tree 91, St. Augustine. *Lay-out.*—Randomized plots in a 4 × 4 Latin Square. Each plot contains 12 trees of one variety (example, Sour Seville) comprising three stocks from each parent tree. Land economy necessitates the whole experiment being divided in half, and the halves placed side by side.

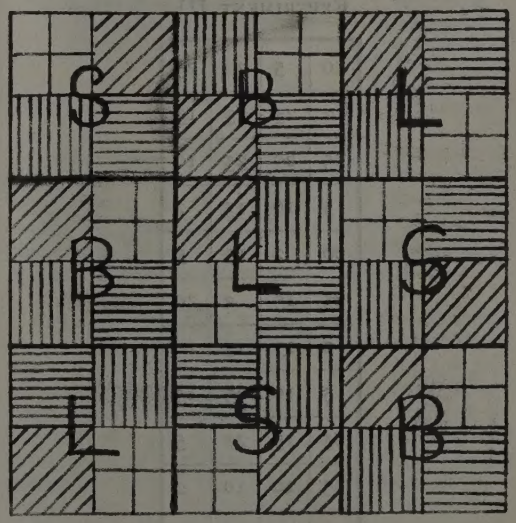
EXPERIMENT I.

h	*e*	*g*	*n*	*o*	*q*	*c*	*d*	*a*	*l*	*j*	*k*
e	*g*	*f*	*p*	*n*	*o*	*b*	*a*	*d*	*k*	*m*	*l*
	B			**D**			**A**			**C**	
f	*h*	*h*	*o*	*q*	*p*	*d*	*b*	*c*	*j*	*k*	*m*
g	*f*	*e*	*q*	*p*	*n*	*a*	*c*	*b*	*m*	*l*	*j*
p	*q*	*o*	*k*	*j*	*k*	*g*	*h*	*e*	*a*	*b*	*d*
o	*n*	*p*	*m*	*i*	*j*	*h*	*e*	*g*	*b*	*d*	*e*
	D			**C**			**B**			**A**	
q	*o*	*n*	*j*	*m*	*l*	*f*	*g*	*f*	*c*	*a*	*b*
n	*p*	*q*	*l*	*k*	*m*	*e*	*f*	*h*	*d*	*c*	*a*
b	*c*	*a*	*h*	*e*	*f*	*m*	*j*	*k*	*o*	*n*	*p*
a	*d*	*b*	*e*	*g*	*h*	*j*	*k*	*l*	*n*	*o*	*q*
	A			**B**			**C**			**D**	
d	*a*	*c*	*g*	*f*	*e*	*k*	*l*	*m*	*q*	*p*	*n*
c	*b*	*d*	*f*	*h*	*g*	*l*	*m*	*j*	*p*	*q*	*o*
l	*k*	*m*	*b*	*d*	*a*	*o*	*q*	*n*	*g*	*e*	*h*
j	*l*	*k*	*d*	*a*	*c*	*q*	*n*	*o*	*h*	*f*	*e*
	C			**A**			**D**			**B**	
m	*j*	*l*	*c*	*b*	*d*	*n*	*o*	*p*	*e*	*g*	*f*
k	*m*	*j*	*a*	*c*	*b*	*p*	*p*	*q*	*f*	*h*	*g*

A = *Sour Seville.*
B = *Sweet Seville.*
C = *Rough Lemon.*
D = *"Wild" Grapefruit.*

a-q = *stocks from different parent trees.*

EXPERIMENT II.



S = *Seedlings.*
B = *Budded on self.*
L = *Layer.*

= *Sour Seville.*
= *Sweet Seville.*
= *Rough Lemon.*
= *"Wild" Grapefruit.*

Experiment II.—Comparison of Stocks for Growth and Disease Resistance.

Aim.—To study relative growth and resistance to gummosis of Sour Seville, Sweet Seville, Rough Lemon, and "Wild" Grapefruit as groups and individuals.

Kinds of planting material.—(*a*) Seedlings. (*b*) Parent budded on its own seedling. (*c*) Layers. *Lay-out.*—A 3 × 3 Latin Square. Each plot contains 16 trees divided equally into four sub-plots, arranged at random. One kind of stock only is planted in each sub-plot, but the four trees in most cases are from different parents.

Experiment III.—Height of bud insertion for Grapefruit.

Aim.—To acquire data as to the relationship between height of budding and infection by gummosis of Marsh Grapefruit budded on Sour Seville. *Stocks.*—Sour Seville from tree River 2. *Scions.*—Marsh Grapefruit, tree 91, St. Augustine.

Preparation of planting material.—Six groups with buds inserted at different heights from ground level in each, viz.: 2, 5, 10, 15, 20, and 25 inches respectively. *Lay-out.*—A plot consisting of 6 × 8 trees, each tree forming a sub-plot. The six treatments are randomized in the rows, and each row is a randomized repetition of the treatments. Land arrangements necessitate the plot being divided in half and the halves placed side by side.

Experiment III.

10	5	20	25
2	25	5	15
15	20	25	10
5	10	15	2
20	2	10	5
25	15	2	20
2	25	15	20
5	10	25	15
25	15	20	5
15	20	10	2
10	2	5	25
20	5	2	10

Numbers=height of budding in inches.

Experiment IV.—Root Selection.

Aim.—To acquire data as to the effect of different tap-roots on aerial development of grapefruit trees. *Stocks.*—Sour Seville from tree River 2. A first selection was made on 3rd July, 1931, at the time of transplanting the seedlings from the seed beds, the stocks being divided into three groups as follows:—(*a*) straight roots, (*b*) crooked roots, (*c*) definitely benched roots.

On 5th November, 1931, at the second transplanting in the nursery, a further selection was made and the final selection was made on September 1st, 1932, when the trees were planted in their permanent positions. *Scions.*—Marsh Grapefruit, tree 91, St. Augustine. *Lay-out.*—A single row of 15 trees, comprising five repetitions of the three forms of root systems. The arrangement of the trees within each replication was chosen at random.

Experiment IV.

S	B	C	S	C	B	C	B	S	C	S	B	B	S	C

S=straight. *C=crooked.* *B=benched.*

Experiment V.—Cultural Treatments.

Aim.—To compare the effect of various cultural treatments on quality and yield of three different kinds of grapefruit on Sour Seville stocks. *Stocks.*—Sour Seville from tree, River 2. *Scions.*—An equal number of each taken from the following trees:—

Marsh Grapefruit,	tree 108,	St. Augustine.	
Foster	do.	110,	do.
Duncan	do.	127,	do.

Group (1) Cutlassing.

(*a*) *Cutlassed only.*—Cutlass three or four times annually, one cutting to be done at the end of December and the material left *in situ.*

(*b*) *Cutlassed plus additional vegetable mulch.*—Treatment as above, and additional vegetable matter at the rate of 200 lb. dry material per tree to be applied as a mulch.

Group (2) Tillage.

(*a*) *Circle forked and soil mulched.*—Circle fork annually between a radius of 18 inches from the trunk and two feet beyond the spread of the foliage, keeping the area clean-weeded by hoeing for the remainder of the year, and maintaining a dust mulch during the dry season. Cutlass the remainder of the land three or four times annually.

(*b*) *Clean tillage and soil mulch.*—Similar to (*a*) around the trees, the remainder of the land being forked or ploughed once annually, and hoed or harrowed monthly.

GROUP (3) TILLAGE PLUS GREEN MANURE.

(*a*) *Tillage plus green manure.*—Light forking or ploughing in June, followed by harrowing and sowing of green manure. Turn in the latter as it commences to flower.

(*b*) *Tillage plus green manure.*—Similar to (*a*), except that another kind of plant will be used as the green manure.

GROUP (4) TILLAGE PLUS COVER CROP.

(*a*) *Tillage plus cover crop.*—Light forking or ploughing in June, followed by harrowing and sowing of cover crop. Cut cover for mulch in December or January, and repeat all operations annually.

(*b*) *Tillage plus cover crop.*—Similar to (*a*), except that another kind of plant will be used for the cover crop.

Lay-out.—This is in the form of a 4 × 4 Latin Square. Each plot contains 18 trees arranged 3 × 6, and these are divided in half for the purpose of the two cultural sub-treatments in each group. Marsh, Duncan, and Foster varieties are represented in equal numbers in each sub-plot, the arrangement being in the form of a 3 × 3 Latin Square.

EXPERIMENT V.

A 4 B	B 2 A	A 3 B	B 1 A
B 2 A	A 1 B	A 4 B	B 3 A
B 3 A	A 4 B	B 1 A	A 2 B
B 1 A	A 3 B	B 2 A	A 4 B

EXPERIMENT VI.—MANURIAL TREATMENTS.

Aim.—To compare the effect of various treatments with artificial fertilizers and organic manures on quality and yield of Marsh Grapefruit on three kinds of stocks.

Stocks.—An equal number of each taken from the following trees:—Sour Seville tree, River 2, Rough Lemon tree, River 9, "Wild" Grapefruit tree, River 18. *Scions.*—Marsh Grapefruit tree, 108 St. Augustine.

GROUP (1).

(*a*) No manure or fertilizer.
(*b*) Sulphate of potash ½ lb. per tree first year, increasing ½ lb. annually.
(*c*) Superphosphate 2 lb. per tree first year increasing 2 lb. annually.
(*d*) Sulphate of potash and superphosphate in quantities as above.

GROUP (2).

(*e*) No manure or fertilizer.
(*f*) Sulphate of potash in quantities as Group (1) (*b*).
(*g*) Superphosphate in quantities as Group (1) (*c*).
(*h*) Sulphate of potash and superphosphate in quantities as Group (1) (*d*).

} Plus ½ lb. sulphate of ammonia first year, increasing ½ lb. annually.

GROUP (3).

(*i*) No manure or fertilizer.
(*j*) Sulphate of potash in quantities as Group (1) (*b*).
(*k*) Superphosphate in quantities as Group (1) (*c*).
(*l*) Sulphate of potash and superphosphate in quantities as Group (1) (*d*).

} Plus 1 lb. sulphate of ammonia first year, increasing 1 lb. annually.

GROUP (4).

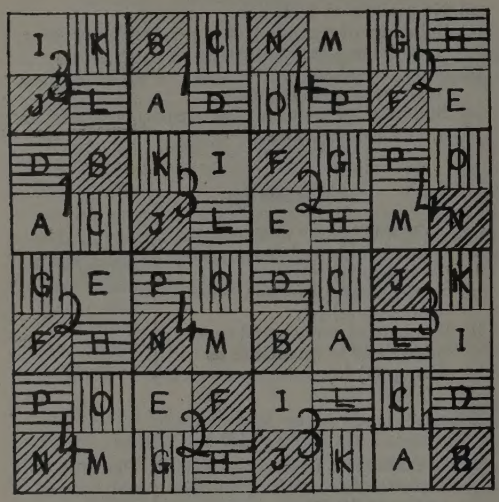
(*m*) No manure or fertilizer.
(*n*) Sulphate of potash in quantities as Group (1) (*b*).
(*o*) Superphosphate in quantities as Group (1) (*c*).
(*p*) Sulphate of potash and superphosphate in quantities as Group (1) (*d*).

} Plus ½ lb. sulphate of ammonia and 50 lb. pen manure first year, increasing ½ lb. and 50 lb. respectively per annum.

General Soil Treatment.—Light forking or ploughing once annually, and controlling weed growth for the remainder of the year by hoeing or harrowing. The manures are to be given in at least two applications, in May and in August, and hoed or harrowed into the soil.

Lay-out.—The four main groups are arranged in a 4 × 4 Latin Square. There are four sub-plots arranged at random in each plot for the purpose of the four sub-treatments in each group. Each sub-plot contains nine trees arranged in the form of a 3 × 3 Latin Square, and containing three trees of each kind of stock, viz.: Rough Lemon, "Wild" Grapefruit, and Sour Seville. Guard rows of grapefruit trees are arranged in such a way that the whole experiment and each sub-plot is completely surrounded by them. They are to be planted with Marsh, Foster and Duncan Grapefruit arranged throughout the plot in the manner shown in the diagram representing a section of Experiment VI.

EXPERIMENT VI.



For explanation of figures and letters see text.

SECTION OF EXPERIMENT VI.

M	F	M	D	M	D	M	F	M
D	G	O	L	F	O	L	G	D
M	L	G	O	M	G	O	L	M
F	O	L	G	D	L	G	O	F
M	D	M	F	M	F	M	D	M
F	G	L	O	D	G	L	O	F
M	O	G	L	M	O	G	L	M
D	L	O	G	F	L	O	G	D
M	F	M	D	M	D	M	F	M

O=*Marsh grapefruit on Sour Seville Orange.*
G=*Marsh grapefruit on "Wild" Grapefruit.*
L=*Marsh grapefruit on Rough Lemon.*

Guard rows { M=*Marsh.* F=*Foster.* D=*Duncan.*

EXPERIMENT VII.—STOCKS FOR ORANGES.

Aim.—(*a*) To test the relative merits of Sour Seville, Sweet Seville, Rough Lemon and "Wild" Grapefruit, as stocks for Washington Navel, Valencia and Pineapple oranges.

(*b*) To test known parent trees in each group as stocks for the above-named varieties of oranges.

Stocks.—Seedlings from four parent trees of each kind of stock are used. *Scions.*—Washington Navel, tree 1, St. Clair. Valencia, tree 65, St. Augustine. Pineapple, tree St. Augustine.

Lay-out.—In three distinct groups, one kind of scion only in each group. In the field, the three groups will be adjacent. The groups are not inter-mixed, as the intention is not to make a comparison of one scion with another. Each group is arranged in the form of a 4 × 4 Latin Square. In each plot, there are four trees of one variety (example, Sour Seville), one from each parent tree. The four trees in each plot are arranged at random.

SECTION OF EXPERIMENT VII.

f *e* **B** *g* *h*	*c* *d* **A** *a* *b*	*l* *j* **C** *m* *k*	*n* *o* **D** *q* *p*
q *p* **D** *o* *n*	*g* *f* **B** *e* *h*	*c* *a* **A** *b* *d*	*m* *l* **C** *j* *k*
j *k* **C** *m* *l*	*p* *n* **D** *q* *o*	*e* *f* **B** *g* *h*	*d* *c* **A** *a* *b*
c *a* **A** *b* *d*	*j* *k* **C** *l* *m*	*n* *o* **D** *p* *q*	*g* *f* **B** *h* *e*

Scions Washington Navel.

Stocks { **A** = *Sour Seville.*
B = *Sweet Seville.*
C = *Rough Lemon.*
D = *"Wild" Grapefruit.*

EXPERIMENT VIII.—HEIGHT OF BUD INSERTION FOR ORANGES.

Aim.—To acquire data as to the relationship between height of budding and infection by gummosis of Jaffa Orange budded on Sour Seville. *Stocks.*—Sour Seville, from tree Barnardo 2. *Scions.*—Jaffa Orange, from tree St. Augustine 32.

The preparation of planting material and the lay-out of the experiment is similar to Experiment III, on grapefruit.

EXPERIMENT VIII.

25	15	10	2	5	20
20	5	25	15	10	2
5	25	20	10	2	15
10	2	15	5	20	25
20	15	5	2	25	10
15	25	20	10	5	2
25	10	15	20	2	5
2	5	25	15	10	20

Numbers=height of budding in inches.

THE CACAO INDUSTRY OF TRINIDAD.

SOME ECONOMIC ASPECTS.

Part V. Section II.

By C. Y. Shephard.

The condition of the cacao industry in 1921 caused Government great anxiety. The financial organisation of the industry had been based on the assumption that high prices would continue. A fall to an unprofitable price level had not been contemplated. Government feared that there would be a general scramble of mortgagees to recall their loans (48). Immediate action was considered imperative. Government was persuaded to protect mortgagors by restricting the rights of mortgagees. The Mortgages Extension Ordinance (23) prevented mortgagees from foreclosing or demanding the repayment of the principal, unless both parties were in agreement, or the interest payments subsequently became at least six months overdue. This Ordinance came into force on 9th December, 1921, and was originally timed to expire on 30th June, 1923. It was regarded as an expedient justified by most exceptional circumstances.

This privilege alone would have been of little assistance to mortgagors. Government therefore introduced the Agricultural Relief Ordinance (4) as a complementary measure. This Ordinance empowered the Relief Committee to make advances from Government funds to the owners of cacao properties for the purposes of carrying on the cultivation, reaping and marketing the produce, paying interest on mortgages and other encumbrances, and meeting necessary personal expenses. Thus, although the rights of mortgagees with regard to foreclosure were restricted, their immediate interests were protected by provision for the payment of interest. It was hoped that these measures would assist the owners in particular and the industry in general to weather the temporary period of distress.

It was urged that the Agricultural Relief Ordinance should come into immediate operation. It was anticipated that the period of distress would be of short duration, and that prices would soon return to a more profitable level. The Committee entrusted with the administration of the Ordinance therefore felt that an elaborate valuation of the property of each applicant, and a comprehensive system of inspection, would defeat the purpose of the scheme by involving unjustifiable expense and intolerable delay. The Committee relied upon a sworn affidavit of the owner and such information as could be acquired without the establishment of special machinery. To safeguard Government funds from the consequences of these inadequate inquiries, the Committee was vested with the power of assuming prior charge on the crops and property without necessarily requiring the consent of existing encumbrancers. Most mortgagees readily gave their consent to the postponement of their claims because the loans assured them of the receipt of interest. In a few instances the consent of the mortgagee was inferred or obtained verbally, and there is only one record of a loan granted despite the definite refusal of the mortgagee.

In several cases the information supplied by the borrowers proved unreliable, particularly with regard to estimated yields of cacao. In other cases the loans were misapplied. When such instances came to the notice of the Committee, investigation was made by the Department of Agriculture or by the Wardens. As a result of these enquiries, frequent alterations were made in the rates of advances, some accounts were closed, and several owners were prosecuted. In general, and within the limits imposed by the nature of its organisation, the Committee endeavoured to grant and regulate advances in the best interests of the owners and Government. Owing to continued low prices, the Mortgages Extension Ordinance was twice extended, and finally allowed to expire on 31st March, 1925. The Agricultural Relief Ordinance was continued during the same period. The Relief Committee was therefore recommended to establish an appropriate system of valuation for the purpose of rejecting unsuitable applicants (46). This proposal was not adopted because the Committee considered the existing methods of valuation unsatisfactory, and its own methods of selection appropriate.

Applications for loans were made in respect of 305 properties, and granted in 186 cases. To 31st December, 1924, the Committee advanced £160,802 5*s.* 8*d.* and recovered £108,817 11*s.* 10*d.* (45). The writer has been unable to obtain a copy of the final balance sheet. In some cases the properties were sold by public auction, or transferred to the mortgagee on payment of all sums due to Government under the Ordinance. The situation was complicated by the facts that several properties were taken over by the mortgagee with the amounts due to Government as a first charge, other accounts were transferred to the Agricultural Bank, and some unsold properties were forfeited to the Crown. Interest on the loans was charged at the rate of 8 per cent. per annum on the daily debit balance. The writer understands that Government eventually recovered by way of repayments, interest, and the disposal of properties, a sum sufficient to cover the total advances, but inadequate to provide interest to Government.

The scheme has been the subject of severe criticism. The assumption by Government of prior claims over existing encumbrancers is said to have brought undue influence to bear on

mortgagees, and to have seriously impaired the credit of the industry. With the merits of these criticisms the writer is not concerned, but it should be stated that the low price of cacao constituted an extremely important factor in curtailing sources of credit. The Agricultural Relief Ordinance was an emergency measure, and the administrative machinery was hastily organised. There can be no doubt that the omission to evolve a suitable method of selecting applicants and ensuring that the loans were properly applied resulted in a number of doubtful advances which further embarrassed both planter and mortgagee. On the other hand, the provision of generous credit facilities at a period when the normal sources were dislocated undoubtedly proved of great assistance to many planters and mortgagees, and tended to mitigate the consequences of the financial panic. The experience gained in the administration of the Agricultural Relief Ordinance was put to good use in organising the Agricultural Bank.

The provision of long-term credit to agriculturists by means of a Land Mortgage Bank had been discussed in Trinidad for many years (42). The low prices obtained during 1920-21 and the three succeeding years, and the break-down of normal sources of credit, led to more definite and practical proposals which resulted in the formation of the Agricultural Bank of Trinidad and Tobago in 1924 (1). This Bank was established "for the purpose of fostering and encouraging agriculture in the Colony and of aiding in the development, maintenance, and improvement of agricultural lands". Its authorised capital is £250,000 of which £25,000 was originally held in reserve*. An Ordinance (51) has been enacted to provide for raising a loan for this purpose, but no actual issue has yet been made, and up to the present the Bank has been financed from surplus funds of the Colony on which the Bank pays interest at the rate of 5 per cent. per annum.

Loans are made "to owners for the development, maintenance and improvement of their land, and the discharge of liabilities incurred in respect of such development, maintenance and improvement, and for such other purposes as may be prescribed". These loans are secured by a first mortgage on the property, and the personal covenant of the owner†. Each year, the borrower is required to pay a sum equivalent to eight per cent. of the original loan by two equal half-yearly instalments, due, respectively, on 30th June and 31st December. Since interest is charged on the outstanding balance at a rate of seven per cent. per annum, each instalment consists partly of principal and partly of interest. With each half-yearly payment the outstanding capital is reduced. Consequently, the portion of the instalment apportioned to interest becomes smaller with each succeeding payment and a correspondingly greater amount becomes available for redemption of the principal. Thus, by 59 half-yearly instalments, each equivalent to four per cent. of the original loan, and a final payment amounting to five and a half per cent., the borrower pays off his entire indebtedness (*see* Table XIV.) The Bank therefore offers planters an opportunity of relieving their properties of encumbrances on easy terms. The importance of this measure can hardly be overstressed. The omission of planters to clear their estates of indebtedness during the long period of prosperity which preceded the slump of 1921 has greatly heightened the incidence of the depression. The present efforts of many planters to pay interest on heavy mortgages have involved a dangerous neglect of cultivation, and reduced many owners to the most desperate financial straits. The Bank provides for its mortgagors facilities whereby such a state of affairs may be mitigated in the future.

The problems of selecting the most suitable applicants, and of determining the extent of the loans which would prove of the greatest benefit to the borrowers and at the same time ensure the safety of Government funds, are grave issues. The ability of the mortgagor to observe his obligations will depend upon the relation between the profits of the estate and the instalments to be paid to the Bank. It is impossible to estimate with any reasonable degree of accuracy the profits which will be earned by a property during a future period of thirty years and six months. Yields, costs of production, and prices, are subject to wide fluctuations. In the majority of cases it is difficult to gauge even the present efficiency of the property for comparatively few planters keep reliable records.

The recognised commercial methods of valuation afforded the Bank little guidance. They were based in some instances upon the number of full-bearing trees (49), and in others upon the number of bags of cacao produced (43). In the first method, the pickets were counted and divided into full-, half-, and quarter-bearing trees, supplies and blanks. The terms full-, half-, and quarter-bearing referred more to the age and general appearance of the trees than to the quantity of cacao they yielded. Thus a full-bearing tree was one in bearing; a half-bearing tree was a young one in flower and not less than three years old; a quarter-bearing tree one not less than two years old; and a supply a tree less than two years old (44).

The valuer took into consideration the suitability of the property for the production of cacao, the actual or estimated yields, the cost of transport to the market, and other relevant factors. By means of this information an arbitrary value was placed upon the full-bearing tree. The standard value was $1.00 (4*s.* 2*d.*) but the assessment for good or bad

* This reserve is now available for investment subject to a minimum of £10,000 being available for temporary advances.

† The personal covenant also applied to private mortgages on cacao estates.

Table XIV.

Prescribed Half-Yearly Instalments for every Hundred Dollars of the Loan.

(SCHEDULE I OF THE AGRICULTURAL BANK ORDINANCE, CHAPTER 132 OF THE REVISED EDITION OF THE LAWS OF TRINIDAD AND TOBAGO, 1925.)

Half-Year.	Prescribed Half-Yearly Instalments.	Apportioned thus:		Balance of Principal owing.
		On account of Interest at seven per cent.	On account of Principal.	
1st	$ 4.00	$ 3.50	$ .50	$ 99.50
2nd	4.00	3.48	.52	98.98
3rd	4.00	3.46	.54	98.44
4th	4.00	3.44	.56	97.88
5th	4.00	3.42	.58	97.30
6th	4.00	3.40	.60	96.70
7th	4.00	3.38	.62	96.08
8th	4.00	3.36	.64	95.44
9th	4.00	3.34	.66	94.78
10th	4.00	3.32	.68	94.10
11th	4.00	3.29	.71	93.39
12th	4.00	3.27	.73	92.66
13th	4.00	3.24	.76	91.90
14th	4.00	3.22	.78	91.12
15th	4.00	3.19	.81	90.31
16th	4.00	3.16	.84	89.47
17th	4.00	3.14	.86	88.61
18th	4.00	3.10	.90	87.71
19th	4.00	3.07	.93	86.78
20th	4.00	3.04	.96	85.82
21st	4.00	3.00	1.00	84.82
22nd	4.00	2.97	1.03	83.79
23rd	4.00	2.93	1.07	82.72
24th	4.00	2.89	1.11	81.61
25th	4.00	2.86	1.14	80.47
26th	4.00	2.82	1.18	79.29
27th	4.00	2.77	1.23	78.06
28th	4.00	2.73	1.27	76.79
29th	4.00	2.69	1.31	75.48
30th	4.00	2.64	1.36	74.12
31st	4.00	2.59	1.41	72.71
32nd	4.00	2.54	1.46	71.25
33rd	4.00	2.49	1.51	69.74
34th	4.00	2.44	1.56	68.18
35th	4.00	2.39	1.61	66.57
36th	4.00	2.33	1.67	64.90
37th	4.00	2.27	1.73	63.17
38th	4.00	2.21	1.79	61.38
39th	4.00	2.15	1.85	59.53
40th	4.00	2.08	1.92	57.61
41st	4.00	2.02	1.98	55.63
42nd	4.00	1.95	2.05	53.58
43rd	4.00	1.87	2.13	51.45
44th	4.00	1.80	2.20	49.25
45th	4.00	1.72	2.28	46.97
46th	4.00	1.64	2.36	44.61
47th	4.00	1.56	2.44	42.17
48th	4.00	1.48	2.52	39.65
49th	4.00	1.39	2.61	37.04
50th	4.00	1.30	2.70	34.34
51st	4.00	1.20	2.80	31.54
52nd	4.00	1.10	2.90	28.64
53rd	4.00	1.00	3.00	25.64
54th	4.00	.90	3.10	22.54
55th	4.00	.79	3.21	19.33
56th	4.00	.68	3.32	16.01
57th	4.00	.56	3.44	12.57
58th	4.00	.44	3.56	9.01
59th	4.00	.31	3.69	5.32
60th	5.51	.19	5.32	—

estates was very much higher or lower. Half- and quarter-bearing trees were valued proportionately, but no payment was made for supplies. Thus, a property, "A", having 11,000 full-bearing, 1,300 half-bearing, and 800 quarter-bearing trees, 900 supplies, and 1,000 missing trees, would have a gross value of $11,800.00 (£2,468 5*s.* 0*d.*) if the full-bearing tree was assessed at $1.00 (4*s.* 2*d.*). This total would be made up of $11,000.00 (£2,291 13*s.* 4*d.*) for 11,000 full-bearing trees at $1.00 each, $650.00 (£135 8*s.* 4*d.*) for 1,300 half-bearing trees at 50 cents (2*s.* 1*d.*) each, and $200.00 (£41 13*s.* 4*d.*) for 800 quarter-bearing trees at 25 cents (1*s.* 0½*d.*) each.

In the second method, the output of the estate during the previous five years was ascertained and expressed in terms of bags each containing 165 lb. of dry cacao. The gross value of the estate was calculated by multiplying the number of bags by a certain factor, which was usually $100.00 (£20 16*s.* 8*d.*). For good or bad estates the factor would be higher or lower. An estate which produced an average of 400 bags of cacao would be valued at $40,000.00 (£8,333 6*s.* 8*d.*) if the factor was assessed at $100.00 (£20 16*s.* 8*d.*).

In both methods the valuations were based on the assumption that the cultivation was in good condition, and that the equipment, such as buildings and stock, was adequate and in a good state of repair. If this proved not to be the case, the amount necessary to restore the cultivation and to repair or augment the equipment was deducted from the gross value. Similarly, the values of cacao under contract (*i.e.*, separate and immature cacao cultivation), land under other crops, rents, and other sources of estate income, were assessed and added to the gross value. In this way, the net value of the property was determined.

Both methods were empirical, and their accuracy was determined primarily by the experience and skill of the valuer. They had the merit of necessitating a detailed and careful examination of the property. They were suited to a period in which, although there were appreciable fluctuations in prices, an average of $20.00 (£4 3*s.* 4*d.*) a bag of cacao could be anticipated with confidence. It is surprising to find that the estimates of expert valuers seldom differed by any appreciable sums. Reasonable valuations were given to most properties, but, as inadequate attention was given to costs of production, there was the danger that in extreme cases a moderate value might be placed upon a property normally incapable of earning profits.

The Bank therefore decided to evolve a system of its own. The mortgagor is required to pay annual instalments equivalent to eight per cent. of the original principal, and the Bank decided to adopt, as the most important factor for estimating its valuations, the profits of the property capitalised at eight per cent. In most cases, however, the neglect to record the financial transactions of the properties makes it impossible to ascertain the profits. The yield of a property can be estimated with reasonable accuracy by expert valuers. The Bank estimates the price of cacao by considering the general trend of the market. Use is made of the records of prices in previous years and of such general information as may appear to have a bearing on the future of cacao prices. Thus, the actual or estimated yield, multiplied by the price determined by the Bank, gives the estimated average annual gross revenue of the property.

As few reliable records of expenditure are available, the "reasonable expenditure" of a property is estimated from tables prepared by the Bank. These tables give the "reasonable expenditure per acre" for properties of different sizes having different yields. Thus, when the acreage under estate cacao cultivation and the yields have been ascertained, the "reasonable expenditure" can be calculated from the appropriate tables (*see* Tables XV and XVI). The excess of revenue over expenditure, when multiplied by twelve and a half, gives the estimated value of the property. Additions are made for :—

"(i) the value of young trees,
(ii) the value of trees in contract,
(iii) an allowance for trees which have not attained to full-bearing,
(iv) the value of other cultivation,
(v) the value of undeveloped land,"

and deductions of :—

"the capital expenditure essential to put the lands and buildings into proper working condition".

These additions and deductions are made on the Inspector's report which is based on lines similar to those employed in valuing on the full-bearing tree basis.

It will be seen that if revenue and expenditure remain at the estimated level during the next 30½ years, loans might be made up to the full value of the property. The Bank, however, recognises that changes in yields, prices, rates of wages, and other relevant factors, may adversely affect the ability of the mortgagor to pay his instalments. For example, even if the basic price was realised the borrower's profits would diminish seriously if he were permitted to neglect his cultivation and allow his yields to decline. The Bank has established a system of periodic inspection, which is carried out by the officers of the Department of Agriculture and other qualified individuals, to ensure that its security is maintained in reasonable condition. Nevertheless the profits of the property may be seriously diminished by factors beyond the control of either the Bank or the mortgagor. The Bank makes provision for such a contingency by stipulating that loans must not exceed fifty per cent. of the estimated value of the property.

Table XV.*

Showing the Estimated Expenditure per Bag of Cacao by Properties of Various Sizes and having Various Yields.

Size of Property in Acres.	Yield in Bags per thousand pickets.†					
	10	9	8	7	6	5
	Yield in lb. per acre.†					
	462	416	370	323	277	231
	$ c.	$ c.	$ c.	$ c.	$ c.	$ c.
5 to 20	8 32	8 73	9 34	10 02	11 06	12 76
21 to 50	8 66	9 11	9 68	10 32	11 35	13 02
51 to 100	9 45	9 91	10 49	11 14	12 14	13 65
101 to 150	9 86	10 32	10 91	11 51	12 69	14 10
151 to 200	10 13	10 60	11 20	11 86	12 89	14 43
201 to 250	10 12	10 59	11 18	11 85	12 88	14 42
251 to 350	9 89	10 36	10 96	11 61	12 63	14 16
351 to 500	9 30	9 81	10 38	10 83	12 03	13 55

Table XVI.*

Showing the Estimated Expenditure per acre of Properties of Various Sizes having Various Yields.

Size of Property in Acres.	Yield in Bags per Thousand Pickets.†					
	10	9	8	7	6	5
	Yield in lb. per acre.†					
	462	416	370	323	277	231
	$ c.	$ c.	$ c.	$ c.	$ c	$ c.
5 to 20	23 32	22 02	20 94	19 64	18 58	17 87
21 to 50	24 24	22 96	21 70	20 24	19 08	18 24
51 to 100	26 46	24 97	23 51	21 84	20 40	19 12
101 to 150	27 61	26 01	24 45	22 67	21 33	19 75
151 to 200	28 36	26 72	25 10	23 26	21 66	20 21
201 to 250	28 34	26 70	25 08	23 24	21 65	20 20
251 to 350	27 71	26 13	24 56	22 77	21 22	19 83
351 to 500	26 16	24 70	23 27	21 23	20 22	18 97

* The Bank uses six tables based on yields varying from 5 to 10 bags per thousand trees. Each table contains details of expenditure per acre on "maintenance of cultivation", "buildings", "stock", "taxes", "supervision" and "crop expenses". The writer has eliminated these details in order to consolidate the information into two tables.

† The Bank uses the yield "per thousand trees". This unit cannot be directly related to yield or expenditure per acre. The writer recommends that yields be calculated on an acreage basis or the equivalent yield per thousand pickets. This basis is used in Tables XV and XVI in calculating the yield in lb. per acre

In addition to these long-term loans the Bank may make temporary advances "for an amount not exceeding £1,050, provided that such amount does not exceed two-thirds of the estimated annual value of the crop to be reaped from the lands upon which the advances are secured". These advances must be applied to all or any of the following purposes:—

"(*i*) The development, maintenance and improvement of the land upon which it is secured, including the payment of labour and the purchase of supplies required to plant, cultivate and manure such land and to reap and make merchantable the crop or produce thereof;"

"(*ii*) Subject to the authority in writing of the Board, the subsistence of the borrower at a scale to be fixed by the Board;"

"(*iii*) Subject to the authority in writing of the Board, the repayment of any loan or mortgage made under Section 8 of the Ordinance, and interest thereon, and the repayment of interest due in respect of any other mortgage or charge on the said land".

Interest on these advances is charged at the rate of eight per cent. per annum. Such loans are made for a period of twelve months, but the date of repayment may be extended for a period not exceeding three years from the date of the first advance.

The Bank has introduced important changes into the methods of financing the proprietors of cacao estates. A careful preliminary enquiry is made as to the credit-worthiness of each property which is calculated according to its profitableness, instead of upon an arbitrary valuation of the number of bags of cacao produced or the number of full-bearing trees. In many cases private mortgagees were content to rely upon the reputation of the owner or the district in which the property was situated, for the industry in general was so prosperous that the risk of failure was considered remote. The Bank's system of amortization requires the owner to liquidate his obligations by small additional payments spread over a long period. If this procedure had been adopted by private mortgagees, or if the Bank had been established half a century ago, many planters might have been free of encumbrances, and would have been better able to withstand the effects of the present depression. The system of amortization would not have suited the small private mortgagee because it would have involved the problem of finding suitable investment for the small sums of principal repaid annually by the borrower. Although the private mortgagee ostensibly required complete repayment at the end of five years, in practice he generally encouraged the borrower to postpone repayments of capital as long as the interest was regularly paid. The aggregate annual repayment of principal to the Bank comprises an appreciable sum which will increase in magnitude for a considerable number of years. As these amounts, together with the profits, are available for re-investment, the Bank is in a position to cater for a small but increasing number of new applicants each year, without any increase in its authorised capital.

The Bank introduced a very important change by establishing close contact between mortgagee and mortgagor. The system of periodic inspection, whereby a deterioration of the property is readily detected, tends to protect the interests of both parties. The owners receive the benefit of independent and expert agricultural advice, while the Bank can insist upon the application of the most advantageous agricultural practices. These measures have resulted in a remarkable improvement in the standard of cultivation on a number of properties, and have prevented a rapid degeneration on others. From the economic point of view, these results are of very great value. Before the Bank was established, few mortgagees exercised supervision of any kind. Numerous mortgagees were engaged in non-agricultural occupations, and many of them were unable to appreciate whether the cultivation was deteriorating, or lacked the ability to indicate how it could be maintained or improved. The system of private mortgages enabled the industry to expand at a rapid rate but was largely responsible for increasing the grave difficulties with which planters are faced today. If the Bank alone had been responsible for financing the cacao industry from its early stages it is unlikely that the industry would have attained its present large dimensions. On the other hand, the existing estates would be more efficient, and fewer planters would be embarrassed by heavy encumbrances.

There are several details of the Agricultural Bank Ordinance and Regulations which merit further discussion. The authorised capital is limited to £250,000 which is insufficient to provide for all owners who desire to obtain loans and who are able to present the necessary security. A few additional properties can be provided for each year from the profits and repayments of principal. The repeated requests of local bodies for an immediate increase of capital have been refused. The maximum loan which may be made on any single property is $25,000.00 (£5,208 6*s*. 8*d*.). This prevents the Bank from catering for many of the larger properties. With the ethics of these decisions the writer is not concerned.

The function of the "tables of reasonable expenditure" has already been described. When these tables were constructed the comprehensive financial tables compiled by the writer and his colleagues were not available. A detailed comparison would prove tedious and unprofitable. It may be stated that the costs of production estimated by the Bank correspond closely with those calculated by the writer from actual estate data. In general, the Bank's "reasonable expenditure per acre" and costs of production per bag are slightly higher, but in no case is the difference of particular significance.

These tables serve the Bank as guides in estimating the expenditure of an estate, but allowances are made for any peculiarities which a property may exhibit. The writer believes that more accurate results would be obtained if the tables were applied to the yields of cacao per acre instead of to the yields "per thousand trees". It has already been explained that cacao yields in Trinidad are expressed in "bags per thousand"

and not in bags or pounds per acre. This method is confusing because it is not invariably clear whether reference is made to a "thousand pickets" or to a "thousand full-bearing trees". The term "one thousand pickets" was originally used as a unit of area because it represents approximately a carrée, or 3 1-5 acres, when the pickets are spaced 12 feet by 12 feet. Thus, a yield of eight bags a thousand pickets is equivalent to 2½ bags an acre*. Many planters calculate their yields in bags per "thousand full-bearing trees" on the ground that blank spaces and immature trees are incapable of contributing any yield. This system is misleading when it is intended to convey an impression of yield per unit of area, for the term a "thousand full-bearing trees" gives no accurate indication of area. It is certain, however, that it represents more than a carrée, although it is often interpreted as being of that area, for an estate with every picket a full-bearing tree is a state of perfection that has never been attained in Trinidad or any other cacao producing country.

The Bank uses two methods to calculate the unit yield of a property. In the first place, if the property is twenty-five years old, or younger, the average total yield in bags is divided by the sum of the number of full-bearing trees and half the number of half-bearing trees; the full number of blanks, supplies, and quarter-bearing trees, and half the number of half-bearing trees is ignored. In the second place, if the property is over twenty-five years of age the total yield is divided by the total number of full-bearing and half-bearing trees, and occasionally quarter-bearing trees; the number of blanks, supplies, and generally, the quarter-bearing trees, is ignored. Invariably the number of bags produced "per thousand trees" is higher than the number produced "per thousand pickets". Unfortunately the "yield per thousand trees" is correlated with the "reasonable expenditure per acre", although the two have no definite relation. The consequence is that in each case the cost of production is lower, and the valuation of the property higher, than it would be if the calculation was made on the basis of "a thousand pickets". For a property with an exceptionally large percentage of full- and half-bearing trees the differences will be small, but in all other cases they will be considerable. The writer therefore recommends that calculations of yield should be based upon the acre in order that they may correspond with the "tables of reasonable expenditure".

The value placed by the Bank upon a bag of cacao is a matter of great importance. A small variation in the price makes a considerable difference to the value of the property, the maximum amount of the loan, and the magnitude of the annual instalments. If, for example, the price of a bag of cacao is estimated at $18.00 (£3 15*s.* 0*d.*), an estate producing 400 bags of cacao per annum at a cost of $11.00 (£2 5*s.* 10*d.*) a bag, would be valued in the following manner at $35,000.00 (£7,291 13*s.* 4*d.*):—

Revenue:		
400 bags at $18.00 a bag (£3 15*s.* 0*d.*)	....	$7,200.00 (£1,500 0*s.* 0*d.*)
Expenditure:		
400 bags at $11.00 a bag (£2 5*s.* 10*d.*)	....	$4,400.00 (£916 13*s.* 4*d.*)
Profit	....	$2,800.00 (£583 6s. 8d.)
Value:		
i.e. Profit Capitalised at 8 %	....	$35,000.00 (£7,291 13*s*, 4*d.*)

If, on the other hand, a bag of cacao is valued at $16.00 (£3 6*s.* 8*d.*) the same estate would be considered worth only $25,000.00 (£5,208 6*s.* 8*d.*).

Revenue:		
400 bags at $16.00 a bag (£3 6*s.* 8*d.*)	....	$6,400.00 (£1,333 6*s.* 8*d.*)
Expenditure:		
400 bags at $11.00 a bag (£2 5*s.* 10*d.*)	....	$4,400.00 (£916 13*s.* 4*d.*)
Profit	....	$2,000.00 (£416 13*s.* 4*d.*)
Value:		
i.e. Profit Capitalised at 8 %	....	$25,000.00 (£5,208 6*s.* 8*d.*)

Thus, if the price is estimated at $18.00 (£3 15*s.* 0*d.*) the maximum loan on this estate will be $17,500.00 (£3,645 16*s.* 8*d.*) and the annual instalment $1,400.00 (£291 13*s.* 4*d.*). If the price is estimated at $16.00 (£3 6*s.* 8*d.*) the maximum loan will be $12,500.00 (£2,604 3*s.* 4*d.*) and the annual instalment $1,000.00. Hence, although the bag of cacao is valued at only 11 per cent. less, the estate is valued at 29 per cent. less.

Although the importance of estimating the value of a bag of cacao at a reasonable figure is recognised, the difficulty of doing so is extremely great. Prices varied considerably before the War but an average of $20.00 (£4 3*s.* 4*d.*) over a long period of years could be relied upon. Since the War the fluctuations have been so violent that the general trend cannot be discerned. Any estimate of the average price likely to be obtained during the next 30 years must be highly speculative. During 1924-25 cacao prices had almost recovered to the pre-War average. The high prices realised during the next three years suggested that this level would be maintained. The Bank, however, adopted the cautious policy of establishing prices approximating to those obtained during the previous five years, which were appreciably lower than current quotations. When prices fell rapidly in 1928-29 the Bank's prices were reduced annually to figures considerably below the average of the previous five years, but higher than prevailing prices. In this manner the Bank has endeavoured to seek out the general trend of prices by avoiding the optimism encouraged by exceptionally high current prices and the pessimism engendered by exceptionally low quotations.

Prices have fluctuated so violently that even this conservative policy has not prevented variations of some magnitude in the prices accepted

* One thousand pickets do not represent a carrée if the space allotted to a picket is greater or smaller.

by the Bank. The effect of these changes in price is to establish different standards of security from year to year. These alterations may be justified by the general prospects of the cacao market, but the writer is of the opinion that the price should be kept from year to year as near as possible to a uniform standard. While recognising the many difficulties that may arise from such a policy the writer would be inclined to fix some arbitrary figure, and to adhere closely to it unless a radical change in the outlook compelled the setting of a revised standard. The closer this standard price approximates to the average that will actually be obtained during the next thirty years, the greater will be its utility. If it is fixed too high it may prejudice the ability of the mortgagor to pay his instalments. If it is too low it may unduly restrict the size of the loan. Unfortunately no one is able to estimate the future trend of prices for so long a period. It is unlikely, however, that the average will be as high as the pre-War level of $21.00 (£4 7*s.* 6*d.*) a bag, because the prospect of such an average price would stimulate enormous production in both old and new areas. Nor is it probable that the average will be as low as that obtained for 1931-32, namely, $11.03 (£2 5*s.* 11½*d.*) a bag, because such a price would eliminate large areas of cacao and discourage new planting. The writer suggests that $15.00 (£3 2*s.* 6*d.*) a bag might be considered a suitable figure. As far as can be judged now, such a price would provide for every efficient property, would exclude definitely uneconomic properties, and would establish a uniform standard of minimum security for mortgagors.

During the course of the present survey, statistics of the average ages of various properties, the yields per thousand pickets, and the costs of production per bag of cacao were collected and analysed. These figures are summarised in Table XVII. This information will be examined more fully in a subsequent article, but as this is the first occasion on which it has been made available it merits a brief discussion in relation to the Bank's activities. Table XVII shows that the estates less than twenty-five years old had the highest average yields and the lowest costs of production.* In the group of estates at least twenty-five but less than forty-five years old, the average yields were 2.67 bags per thousand pickets (109 lb. per acre) less, and the average costs of production $2.91 (12*s.* 1½*d.*) a bag more. The older classes have average yields slightly above or below the class of an average age of thirty-five years. In each case, however, the average costs of production increase with age. If the estates in each class were typical of their average ages it might be expected that an estate would experience an increase in yields and a decrease in costs of production from the time it came into bearing until it reached some age between fifteen and twenty-five years. When this most efficient stage had been passed, a rapid decline in yields and a substantial rise in costs of production might be expected until some age between twenty-five and forty-five years was attained. Thereafter yields might fall or rise slightly but costs of production would increase steadily with age.

The fact is, however, that the older classes are not typical of their age. The estates 55, 75 and more than 85 years of age which were examined are the survivors of a larger number of estates planted 55, 75 or more than 85 years ago. They have survived on account of their high yields and low costs of production. Their contemporaries have failed to survive on account of their low yields and high costs of production. If, therefore, representative groups could be obtained to-day of estates established in the seventies, sixties, and fifties of the nineteenth century it would doubtless be found that their average yields were lower, and their average costs of production higher than those indicated in Table XVII.

In order to obtain a more accurate impression of the influence of age upon cacao properties the writer is conducting an examination of those individual estates and fields for which records are available for many years. This investigation is not yet completed but it confirms the suggestion that most areas of cacao in Trinidad attain their highest yields and produce at the lowest unit costs between the ages of 15 and 25 years. There are a few exceptions in which the peak of production was attained at a later age. On the

Table XVII.

Showing Average Yields and Costs of Production of Trinidad Cacao Estates Selected According to Age.

	Average Age of Estates in Years.				
	Less than 25	35	55	75	More than 85
Yield in Bags per 1,000 Pickets	8.22	5.75	5.52	5.86	5.64
Yield in lb. per Acre	366	257	249	269	269
Cost of Production in dollars per Bag	8.96	11.87	12.54	13.70	14.52
Number of Estates examined	38	65	35	14	10
Total Cacao Acreage of Estates examined	7,508	15,000	9,151	3,380	1,648

* A more detailed examination reveals the fact that the class of estates at least 15 but less than 25 years old obtained the highest yields at the lowest costs of production.

other hand, this new information amplifies that contained in Table XVII by showing that there is a continuous tendency for yields to decrease once the peak has been passed. The rate of decline appears to be greatest between the ages of 20 and 35 years.

This information is of great significance to the Bank because loans are granted for a long period and many of the properties on which mortgages are held are less than twenty-five years old. It suggests that the age factor should be taken into careful consideration, particularly with properties which are about their most efficient age. The writer's investigations would be far more valuable to the Bank if he were able to give a clear indication of the relative importance of the various factors associated with age which result in declining yields and increasing costs of production after a certain age. Although the character of the more important factors is fairly clear the ability to assess their influence must await further research. It may be stated, however, that senescence is not the only factor and that the Bank's system of inspection and insistence upon the maintenance of a reasonable standard of cultivation—to which the writer attaches great importance—will certainly help to counteract the tendency towards a decline in efficiency.

The writer's recommendations are briefly, that yield should be estimated on an acreage basis, that the value of a bag of cacao should be stabilised at $15.00 (£3 2*s.* 6*d.*), and that the age of a property should be taken into careful consideration. The effect of these modifications would be a reduction in the estimated value of nearly every property. The yield per thousand pickets is invariably lower than the yield per thousand trees. Therefore the yield per acre would be lower than the yield obtained by dividing the yield per thousand trees by the average number of pickets per acre. In consequence, the "reasonable expenditure per acre" and the estimated cost of production per bag of cacao would be raised, and the profit and value reduced. The suggested price of $15.00 (£3 2*s.* 6*d.*) a bag of cacao is lower than the price used in any year prior to 1931-32. An allowance for age would reduce the value of every property, excepting, perhaps, the very young ones. On the other hand, most of the factors which can be foreseen would be taken into consideration. The reduced values would not necessarily involve a corresponding reduction in the actual loans, because many owners have applied for amounts smaller than the maximum.

Although the Bank can satisfy itself as to the ability of a mortgagor to meet his obligations over the period of the loan there is no guarantee that he will be able to do so in each and every year. During the past twelve years there have been seven in which low prices were obtained. The average price obtained by the Cocoa Planters' Association during the past two years was $11.21 (£2 6*s.* 8½*d.*) a bag. During the twelve months, July 1931 to June 1932, the planters were handicapped by a late crop and low yields in addition to receiving the lowest prices recorded during the past 100 years. The Cocoa Planters' Association, for example, handled only 7½ million pounds of cacao during this period, compared with 11¼ million pounds during the previous 12 months. Low prices have afforded little opportunity for the collection of reserves, and the profits realised by many mortgagors have been too small to pay interest on encumbrances. The mortgagors of the Bank have the opportunity of obtaining temporary advances to enable them to pay their instalments, provided the total amount advanced exceeds neither £1,050, nor two-thirds of the estimated value of the crop. The Bank may extend the date of repayment for a period not exceeding three years from the date of the first advance, but if repayment is not then completed no further advance can be made.

This concession is of very great value to mortgagors because it makes generous provision for the fluctuations in prices which may be expected from time to time. Prices have fallen to such unexpectedly low levels that even this facility has proved inadequate in a number of cases, and unless there is a marked improvement in prices in the immediate future many other mortgagors will become financially involved. Government has already recognised the gravity of the situation by establishing a system of relief under the Cocoa Industry Relief Ordinance. There is a danger that mortgagors of the Bank who have reached the limit of the credit facilities provided by this institution will find it necessary to neglect their cultivation seriously, in order to continue the payment of instalments. Yet the security demanded by the Bank is such that most of these properties should earn sufficiently large profits in the future to enable the instalments to be met during the allotted period. Under these extremely exceptional and unforeseen conditions, for which the Bank could not be expected to cater, there would appear to be strong economic arguments for providing these mortgagors with additional credit under the Relief Ordinance which is designed to meet, and owes its existence to, a period of acute distress. Such relief should be made subject to the conditions that the cultivation is kept at a reasonable standard, and that the owner is making an honest attempt to observe his obligations. The Bank's system of periodic inspection would enable it to ascertain whether effect was being given to these requirements. Such an arrangement would be to the economic advantage of the Bank, the mortgagors, and the industry as a whole. Many private and mercantile mortgagees have had to recognise the inability of their mortgagors to continue the full payment of interest. Several large merchants have waived the commission of 2½ per cent. which is normally charged on the produce of a property mortgaged to them. Many mortgagees have permitted the mortgagor to pay his interest in part, or entirely to postpone all interest payments. Such concessions may be dangerous

unless they are accompanied by periodic inspections to ensure that the property is receiving reasonable attention.

The Bank has under consideration a modification of its Regulations which the writer considers might be made with advantage. A mortgagor, with the consent of the Bank, may meet his obligations by larger instalments than those required by the Regulations, or he may reduce the outstanding principal by lump sums. In either case the effect is to reduce the duration of the loan. These concessions are worthy of encouragement for they provide the mortgagor with a useful investment in times of prosperity. If the mortgagor disposes of a portion of his property, *e.g.*, for the construction or improvement of public roads, the proceeds must be paid to the Bank. In such an instance, the half-yearly instalments must be maintained at their original level, though for a shorter period. The sale of a portion of a property reduces both its earning capacity and the security held by the Bank. On the other hand, the proceeds of the sale diminish the risk taken by the Bank in greater measure since loans may never exceed, but may be considerably less than half the value of the property. Circumstances may arise in which the disposal of a substantial portion of the property may make it impossible to maintain the instalments at their original level. The only manner in which adjustment can now be made is by the cumbersome and costly process of obtaining a release and drawing up a new deed. The writer therefore supports the proposal that the Bank should be permitted to re-assess the half-yearly instalments in a manner that would permit the payments to be completed in the original period of thirty years and six months. A similar concession might be granted to those who have anticipated instalments in any other manner. Such modifications would appear to be to the advantage of both the Bank and its mortgagors.

Table XVIII.

Showing Classification of Mortgaged Properties against which Loans have been made by the Agricultural Bank to the 31st December, 1931. (3).

Class.	No. of Borrowers.	Total of individual Loans of.									Total.		
		£500 and under.			Over £500.								
		£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
1 to 100 acres.													
Up to 10 acres	55	6,458	6	8		..					6,458	6	8
11 to 25 acres	112	22,417	19	7	3,020	16	8				25,438	16	3
26 to 50 acres	69	13,833	6	8	18,462	0	5½				32,295	7	1½
51 to 100 acres	57	2,960	1	0½	54,158	5	5				57,118	6	5½
Total	293	45,669	13	11½	75,641	2	6½				121,310	16	6
101 to 500 acres.													
101 to 200 acres	36	833	6	8	53,471	4	0				54,304	10	8
201 to 300 acres	16	312	10	0	30,919	5	10				31,231	15	10
301 to 400 acres	6	..			17,916	13	4				17,916	13	4
401 to 500 acres	9	..			29,489	4	7				29,489	4	7
Total	67	1,145	16	8	131,796	7	9				132,942	4	5
Grand Total	360	46,815	10	7½	207,437	10	3½				254,253	0	11

Table XIX.

Showing Amounts Loaned on Mortgage, and Instalments received towards the Reduction of Loans, since the Inception of the Agricultural Bank to 31st December, 1931. (3).

Period.	No. of Borrowers	Amount Advanced.			Amount repaid.			Balance Outstanding.		
		£	s.	d.	£	s.	d.	£	s.	d.
Nov. 24th to 31st Dec., 1925 ..	124	79,604	3	4	1,817	13	9	77,786	9	7
Year 1926	72	42,156	5	0	871	4	9½	119,071	9	9½
Year 1927	37	21,208	6	8	6,609	2	2½	133,670	14	3
Year 1928	32	21,437	10	0	3,876	18	10	151,231	5	5
Year 1929	41	57,593	15	0	7,143	8	9	201,681	11	8
Year 1930	27	17,086	14	4½	5,041	9	5½	213,726	16	7
Year 1931	27	15,166	6	6½	5,546	10	5	223,346	12	8½
		254,253	0	11	30,906	8	2½	..		

The writer is not entitled to discuss the propriety of Government's decision to provide credit facilities for a special class of investors, and to limit this aid to a portion of a particular section of an industry. The policy has precedents in many countries. There is no doubt that the institution is highly appreciated in Trinidad, the principal criticism being that its authorised capital is inadequate. The Bank has met with considerable success in the difficult task of attempting to arrive at a satisfactory compromise between the wishes of the cacao planters and the need for ensuring the safety of Government funds. The organisation of the Bank represents a remarkable advance upon previous methods of financing the cacao industry. The Bank has always been alive to the advisability of introducing such modifications as are rendered desirable by developments in our knowledge of the industry or by changes in circumstances. Several notable improvements have already been effected as the result of experience gained during the short period in which the Bank has been in existence. The writer hopes that his recommendations relating to matters of detail, which are largely based upon hitherto unpublished data, will prove of assistance to the Bank and the industry it serves.

Additional Literature.

(For previous references *see Tropical Agriculture*, Vol. IX, No. VIII, August, 1932, pages 242-43).

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WEST INDIAN NOTES.

Compiled by the Agricultural Advisory Department, Imperial College of Tropical Agriculture.

Weather conditions throughout the West Indies have been rather unusual during the past few months, the rainfall in all the islands being rather above the average, and, in some instances, considerably above the average. As a result, crops generally look well, sugar-cane especially being far advanced for the time of the year. The output of the sugar in the season just closed has been a record. In round numbers, the figures are:—Barbados, 100,000 tons, Trinidad, 90,000 tons, St. Kitts, 20,000 tons, Antigua 19,000 tons, and St. Lucia, 5,400 tons.

Work on the control of the moth borer has been continued in Barbados. Mr. R. W. E. Tucker carried on his field and factory-yard observations throughout the season, and the parasite liberations have also been continued. Preparations have been made for increasing the distribution of the parasite in Barbados in the coming season. In Antigua and St. Kitts, further consignments of *Lixophaga* collected in Cuba by Dr. J. G. Myers have been liberated, and the adult flies and parasitized moth borer caterpillars have been recovered in the fields.

At the International Conference of Sugar-Cane Technologists held at Puerto Rico in March, 1932, a resolution was passed in which it was stated that the entomologists present could not endorse the method of moth borer control by the breeding and liberation of *Trichogramma* until more definite statistical information is available. This method is in use in Barbados and in Louisiana, and, in both these places, the entomologists in charge as well as the sugar planters are satisfied that the work is of sufficient value to be carried on for a longer period. In these places, continued attempts should result in the accumulation of further statistical evidence as to the value of the method.

If the *Lixophaga* introductions prove to be as successful as indicated by the results so far obtained in Antigua and St. Kitts, it is likely that the *Lixophaga* method will supersede the *Trichogramma* method of control, as the former seems to be much the cheaper of the two.

The Fruit and Vegetable Industry.

The principal trade during the quarterly period under review has been that in green limes to the United States. The peak of shipments has now passed and it is evident that the 1932 crop will not equal that of 1931. This is clearly illustrated by the following figures:—

Exporter.	1931. Total Barrels.	1931 to July 31st. Barrels.	1932 to July 31st. Barrels.
Dominica ..	10,530	6,947	4,514
St. Lucia ..	3,282	2,850	2,124

The crop has been generally on the short side and the plantings in recent years, particularly those in Dominica following the hurricane damage, are not yet sufficiently advanced to give much return, although many are beginning to crop. The exports to destinations other than the United States are as follows :—

Exporter.	1931. Total Barrels.	1932 to July 31st. Barrels. (Approximately.)
Dominica ..	351	300
St. Lucia ..	807	500

A large proportion of these exports goes to Bermuda, particularly from St. Lucia, and the balance is divided between Canada and the United Kingdom. The Montserrat green lime export is yet relatively small (290 barrels in 1931) but this is largely due to juice contracts of long standing. With recent plantings, however, the present acreage under limes is estimated at about 1,000, and thus the Montserrat exports should increase appreciably within the next few years.

Shipments of limes have been sent to Canada regularly this summer from Dominica, and irregularly from St. Lucia and Montserrat, the principal package used being the 20 lb. tomato crate ($\frac{3}{4}$ cu. ft.) of which about 1,700 have gone forward. The gross prices realised have ranged between $1.50 and $2.25, mostly larger "medium" and "large" limes being shipped. There is every indication that a demand for this fruit, hitherto virtually unknown in Canada, is being established.

At the time of writing (the end of August) the mango season is practically finished. As in previous years shipments have been made principally to Bermuda, small quantities being sent to Canada and the United Kingdom. Up to the end of July, 3,086 crates (citrus, half-citrus and tomato crates) were sent from St. Lucia, the average package being the 1 cu. ft. half-citrus crate. During the same period Dominica exported the equivalent of 810 full citrus crates (the usual package) of common mangoes, and 175 tomato crates of fruit of grafted varieties, mostly Julie and some Ceylon. Mango exports from other islands were negligible. The crop was smaller than that in 1931 since more rain fell this year in the dry season. Shipments of common mangoes from Dominica after early July practically ceased because of fruit fly damage ; this did not, however, affect the St. Lucia crop.

The avocado pear season is now in progress. Up to the end of July, 1,215 single layer crates were sent from St. Lucia and 580 from Dominica, mostly to Bermuda. It is hoped to make some late season shipments at the end of the year from Grenada where the crop is later than in St. Lucia and Dominica.

Recent returns to the Dominica Marketing Depot have averaged, after deducting packing, shipping and selling charges—common mangoes, 4s. per citrus crate ; Julie mangoes, 4s. per tomato crate ; limes, 6s. per citrus crate ; pears (early season prices), 4s. per tomato crate.

All the figures for last season's tomato crop are now to hand and show a return of from 1c. to 1.5c. per lb. to the grower in the various islands. Montserrat is contemplating an export of at least 40,000 crates during the coming season and planting is now in full swing. Shipments should start early in November. St. Vincent will again produce tomatoes but it is unlikely that last season's total (9,000) will be exceeded. The export from the Northern Leeward Islands is as yet indefinite, but is not likely to be appreciable. With present returns the crop is best suited to peasant cultivation where labour and transport costs do not generally have to be considered.

Miscellaneous.

Mr. H. A. Ballou, Commissioner of Agriculture, sailed on 4th July, on a tour of the Leeward Islands and St. Lucia, and returned on 30th July.

* * *

Mr. G. A. Jones, Assistant Commissioner of Agriculture, proceeded on leave on 30th May, and is expected to return towards the end of September.

* * *

Mr. R. A. Kitching, Agricultural Officer, Dominica, has been seconded for duty in British Honduras. Mr. Kitching left Dominica on 15th July.

* * *

During recent months, considerable interest has been shown in tonka beans by planters in Dominica, and seeds have been forwarded from Trinidad for planting.

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An Indian strain of cauliflower has been tried in the last two or three years in certain of the islands, and more extended trials are to be made this year in St. Kitts and Montserrat.

* * *

In Montserrat and St. Kitts, the cotton crop planted in March has made good growth. The area planted has been greatly reduced ; in Montserrat it probably does not exceed 1,000 acres, and in St. Kitts, 200 acres.

* * *

Dr. J. G. Myers and Mr. J. D. Vezey-Fitzgerald are at present in Brazil searching for parasites, principally of the sugar-cane froghopper.

Mr. Vezey-Fitzgerald has just finished a post-graduate course at the Imperial College of Tropical Agriculture. It is expected that about six months will be spent in this expedition, which is under the direction of the Sugar Cane-Investigation Committee of Trinidad and Tobago.

* * *

The West Indian Notes which appeared in *Tropical Agriculture* for July last contain a reference to the distribution of Nigerian onion seed. Reports on this seed are not favourable; the seed failed to germinate in all the islands where it was tried.

* * *

Mr. C. K. Robinson has been appointed special officer to investigate arrowroot problems, especially the control of the arrowroot leaf roller caterpillar. He will proceed to St. Vincent to take up the duties of the appointment in November. This appointment is made by the St. Vincent Arrowroot Association.

* * *

The Central Quarantine Station which was recommended by the Imperial Sugar-Cane Conference, London, 1931, has been definitely approved, and the necessary funds have been provided. The Sugar-Cane Breeding Station which it was recommended should be established in Barbados to serve the needs of the West Indies, is expected to be provided for in the near future. The Central Quarantine Station is to be located in Trinidad, at or near the Imperial College of Tropical Agriculture, but it is to be under the control of the Trinidad Government.

* * *

During the visit of the Canadian Trade Ship, the *New Northland*, in Fel ruary last, the Canadian merchants on board were interested in the West Indian sorrel drink. This drink appears to have made a strong impression, and inquiries have now been received as to the possibility of growing the sorrel as a crop with the object of obtaining an extract which could be used for flavouring sweet drinks in Canada. The sorrel (*Hibiscus sabdariffa*) grows well throughout the West Indies, and the possibility of developing a trade seems to depend on the extent of the demand and the prices which could be realized for this crop.

* * *

In March, 1931, Mr. H. C. Sampson, Economic Botanist, Kew, forwarded to the Commissioner of Agriculture a parcel of seeds of *Alysicarpus rugosus* for trial in the West Indies. This plant occurs in India and other Eastern countries. The seed which was received came from Central Provinces, India. This seed was distributed to several of the West Indian Islands, and the report states that, on the light soils of St. Kitts and St. Vincent, the seeds germinated well, the plants made good growth and set seeds freely. Further trials are being made, and it is hoped that this plant will be established as a green dressing and fodder crop. *Alysicarpus rugosus* was said to be a common, indigenous, leguminous weed in the Central Provinces, where it has been tried as a cattle fodder with satisfactory results. Cattle appear to eat it with relish, and the outturn was highly satisfactory. The following table gives the yield of the more important fodder crops which were grown at the botanical area of Central Provinces, India, during the year under report:—

Alysicarpus rugosus ..	21,800	*lb. per acre.*
Dolichos lablab	14,038	do.
Stizolobium	13,227	do.
Glycine hispida (*Java black*)	9,942	do.
Glycine hispida	9,939	do.
Cyamopsis psoralioides ..	8,300	do.
Vigna catjang	6,690	do.

* * *

Considerable interest is being taken in the growing of the cashew nut as a possible crop. The Agricultural Society, Trinidad and Tobago, has appointed a Committee to go fully into the matter concerning the possibilities of a crop production in Trinidad. Samples of prepared cashew nuts appear to have made a favourable impression with dealers in New York, but for this product to hold a place in a large market, it will be necessary for a very large production to be available. The American market is very largely supplied at the present time from Eastern sources, chiefly India. For the most part, the cashew in the West Indies is grown without cultivation, as scattered trees on waste land. There are, however, small groups of trees and some plantations in Trinidad, and at least one plantation of some size in Dominica. Inquiries have been received as to the prospects in other places. Apparently, there is a considerable range in the size and weight of the nuts produced, and results of the investigations of the Trinidad Agricultural Society are being awaited with interest. In addition to the nuts, which are used for confectionery purposes and as a table nut, there is a prospect that the oil from the seed-coat will be of considerable value, and that the so-called fruit (which is really a fleshy receptacle on which the seed is borne) can be utilized for the preparation of a wine or as a preserve.

THE subscription to *Tropical Agriculture* is six shillings per annum, post free, Trinidad currency, to all countries within the British Empire or seven shillings and sixpence, post free, Trinidad currency, to all other countries. Subscriptions can commence at any time during the year.

STUDIES IN TROPICAL LAND TENURE.

By H. Martin Leake, Sc.D.

(3) The Eastern Colonies.

The history of land tenure in the Eastern Colonies offers some marked similarities and some equally marked contrasts to that of the West Indies. The essential similarity lies in that same competition between the European maritime nations for control but, with Spain fully occupied in the western hemisphere, the nationalities concerned are different. Competition here is between the Portuguese, the Dutch and the English. For the differences it is not necessary to search deeply for an explanation. They are not to be found in the morality of the conquerors which differed little and was typical of the time. The three factors influencing development in the east were, first, the length and difficulty of the route which imposed a strict limitation on the volume of the eastward traffic; second, the absence of any temperate lands suited for settlement which might have constituted an urge to white settlement; third, and perhaps the most weighty factor, the presence of populous, virile and, for the period, highly civilized races, very different from those encountered on the American continent and quite capable of meeting force with force. The movement eastwards arose from the known wealth of the east and it was primarily a trading movement. The primary objective, first of the Portuguese and then of the Dutch, was to oust the Arab traders who for long had held a monopoly of the trade of these seas as far as the west was concerned; the second objective, after the accomplishment of the first, was to establish a monopoly of that trade for their own nationals. Trade and not occupation or settlement was the main consideration and, as in India, occupation was an incident in the process to which the nationalities were driven for the protection of that trade. This statement applies not only to the earlier Portuguese and Dutch incursions; it applies equally to the English as a perusal of the documents of the time, such as Raffles' report on Malacca (1), sufficiently indicates. Occupation in this sense takes the form of assuming in practice, whether directly or indirectly through the existing authority, the direction of Government. There is here no question of starting *de novo*; there is an indigenous system which is carried on, frequently, it is true, regularized and developed; and in that development an European bias and European terminology frequently creeps in. That Europeanization of the system, however, is incidental and accidental, and arises from a failure to understand the indigenous attitude towards land. It finds its counterpart in India in the failure to comprehend the true status of the *zamindar* in the economy of the State. Owing, however, to their later occupation by the British, at a time when the soundness of the Permanent Settlement of Bengal was already being questioned, possibly, too, owing to the fact that the early British occupation of both colonies was directed from India, a closer approximation to the native system was maintained than was the case in India. Thus, the true position was that the indigenous system was retained as far as it was understood, the development was evolutionary, not revolutionary, and in that indigenous system must be sought the basis of the tenure systems now in vogue. There are many points of similarity between the systems of Ceylon and Malaya and though the latter country has been opened up at a more recent date than the former, it will be convenient to deal with the Malayan system first. Partly this is because the system is seen to better advantage here but partly, also, because there exists a very illuminating account of the principles from the pen of Maxwell (2).

Malaya.

Pre-European Period.

The key to the Malayan land system is to be found in the fact that Malaya is a thinly populated country covered with dense jungle, the labour of clearing which is onerous. As in all such cases, the need for securing a sufficiency of cultivation sets a bound to the exercise of autocratic power by the ruler. Though, therefore, the ownership of the land was definitely vested in the ruler, originally native chiefs and later, as the result of the Aryan invasion, Rajas, the outward and visible signs of that ownership were strictly limited. Whatever form the subordination of the people to the chief might take in other matters, a certain security in land was essential if the labour of clearing was to be undertaken and the people were to be induced to cultivate at all. Hence arose the custom of a recognition of a permanent right to such land as was cleared and brought under cultivation. Further, no restrictions were imposed on the right to clear; a free choice was open to all to clear any land for cultivation, but the right, though permanent, was subject to definite limitations. Thus, it must be continuously cultivated and failure to fulfil this condition would lead to its resumption. In this condition, more clearly than in any other, lies the evidence of the strength of the ruler's claim to the land as such. That this claim is no mere hypothesis is clear from the rules concerning resumption. Land was considered to be of two classes, *tanah mati* (dead land), forest and abandoned land, and *tanah hidop* (live land), cultivated land. Cultivation assumed three forms and according to these the land was classed as

(1) *tanah kampong*—land planted to fruit trees,
(2) *tanah bendang* or *sawah*—wet rice land,
(3) *tanah huma* or *ladang*—shifting hill cultivation.

The limited proprietary right was maintained in the first case as long as the trees remained in evidence; in the second case during cultivation and for a period of three years succeeding the last crop raised; in the third case only during cultivation. This last case is typical of many countries with a primitive element in the population. Land is cleared by burning and one or, at most, two crops taken off when the land is allowed to revert to bush and a clearing made elsewhere. A right is, thus, only desired and granted during the short period of cultivation.

But if the sparseness of the population placed a limit on the exercise of undue autocratic power by the ruler directly through the land, there were other conditions attached to the right to cultivate which offered greater opportunity for the exercise of that power. They were, the payment of a tithe of the produce and the liability to service. Under the first of these power was limited, for tithe was determined as that fraction so generally found throughout the east, one-tenth of the produce. The method of assessment varied but was usually effected on the spot, while the crop was still standing, by a representative of Government, the village headman and the cultivator, and the assessment delivered in kind or in money value into the treasury. Exceptionally, as in certain districts from which most of the grain was exported, the tenth was levied at the time and place of export or, as in Perak, where cultivation was subordinate to mining, the tithe might be remitted.

Limitation of the amount to be exacted, combined with that independence when land is abundant, limited, as already mentioned, the oppression possible through the assessment. These restrictions, however, did not apply in the case of that third condition of tenure, forced labour or service. It was a condition of which full advantage was taken to the extent that children might be taken away, the girls for the seraglio and the youths for service or war. This association of forced service, however, derives its importance from another aspect which must be briefly detailed.

If the rights of the chief, or Raja, over the land were limited by absence of power to evict at pleasure, his rights to exact the tithe up to the one-tenth of the produce and his right to demand service were otherwise unrestricted. He was at liberty to dispose of those rights as and how he pleased. Among the customs of the country are found payment for services, and rewards to favourites by grants over certain tracts of land. Such grants, however, merely transferred the Raja's rights to the beneficiary, the right to dispose of uncultivated land, to collect the tithe on cultivated land and to exact forced service; they conferred no right to interfere with the cultivator so long as he fulfilled the requirements of his tenure. The cultivator, thus, was concerned only with his immediate superior and did not look beyond him to the chief or Raja. The possibilities of oppression through demands for forced labour were multiplied many-fold by this decentralization.

As long as the cultivator fulfilled his liabilities in the matter of continuous cultivation, payment of tithe and forced service, his tenure was permanent though falling short of full proprietary possession. The right was heritable and transferable. With regard to inheritance the rules were complicated and varied in different localities. The complexity arose mainly from the superimposition, partial or complete, of Mohammedan law on indigenous custom. That custom, though it tended, as did Mohammedan law, to partition, tended also to keep the land within the family circle. Transfer was uncontrolled so long as the conditions of service were maintained, though the Raja's concurrence might be necessary to validate it, and such transfer might take the form of sub-letting, in which case the proprietor of the first order stood in the same relation to the proprietor of the second order as he himself stood in relation to the chief; that is, the right of the tenant, if it be correct to use the term in this connection, was permanent subject to fulfilment of the customary conditions. It may be added, in concluding this brief description, that in most of these matters the rights are based on custom and are rarely reduced to writing. The codes which are extant, such as the Malacca code dating about A.H. 673 (A.D. 1275) and of which a translation is given by Newbold (3), do not define these rights and customs in regard to land in any great detail.

Early European Period.

There is little need to dwell on this period since neither the Portuguese nor, later, the Dutch obtained any real hold over the country and their occupation was limited to the establishment of trading stations protected by forts from which they attempted to secure, and partially succeeded in establishing, a monopoly over the export trade. That function, too, was secondary and mainly referred to tin; the main function of these settlements, of which the chief was Malacca, was the control of the sea-borne trade of those seas. Within the settlement area, mainly town land, they regulated native custom by the issue of certificates of titles and by checking the secret transfer of land, but they did not interfere with the interpretation of those customary rights. In exercise of their claim over the interior, the Dutch granted tracts as *terres particulières* to Dutch settlers, traders, officials and, in some cases, natives, but these grants did not interfere with the customary rights of the inhabitants and, in view of the precarious nature of the Dutch claim, were worth very little. Their importance lies in the fact that they created a body of claimants to titles which were capable, as in the case of zamindari rights in India, of misinterpretation. The major Dutch effort took another direction, the control

of cultivation, the interdiction of the cultivation of grain as interfering with their monopoly in Java, and forced service. An account of these activities of the Dutch is given by Blundell (4) but the main features of their rule are seen in a clearer light in Java over which they obtained a hold which gave a power of enforcement never secured in Malaya.

The British Period.

The earliest foothold obtained by the British in the territory followed the practice of the Portuguese and Dutch and consisted of fortified trading stations. Malacca came under British control in 1795 but little change on previous systems of rule were effected before 1825 except for the removal of the restrictions on cultivation imposed by the Dutch. In that year British possession was finally established and the new Government was faced with a number of claimants to proprietorship to the *terres particulières*, the basis of their claim being the titles issued by the Dutch. In the current ignorance of the local custom in the matter of land, there was no small risk that these claims would be converted into full manorial rights. Fortunately, by the year 1828, when a decision was taken, the position had become clearer mainly owing to the discovery of a Dutch Proclamation dated 1775, and most of the concessions were repurchased by Government. With this source of complexity removed, the way was open for a satisfactory solution of the land problem. As a result of the discussions Regulation 9 of 1830 was approved by the Board of Directors—for the Settlements did not come under the Colonial Office till 1867. This Regulation, however, proved the source of much mischief for it introduced an extraordinary discrimination between title holders who, in customary law, were equal. Three measures were involved:

(1) direct collection of the tenth from the resumed areas,
(2) the issue of title deeds, after survey, to cultivators in possession,
(3) subsequent alienation by grant or lease under English law.

This Regulation proved abortive in respect of the first measure because no procedure was laid down for the collection of the tenth. Failure to organize any effective survey was largely responsible for the breakdown of the two latter measures for it soon became impossible to distinguish land entitled to be registered under (2) from land more recently opened up. Further, the decision to introduce an alien system, not comprehended by the cultivator, was a grave error; the efforts to enforce it provide illuminating reading, and were effectively countered by passive resistance. Matters drifted on till 1861 when the Gordian knot was cut by India, Act 26 of 1861, which gave recognition to those cultivators only who could prove a title under customary tenure and who were given the option of converting the liability to pay the tenth to a cash payment and a quit rent. Those who were unable to substantiate their title were given an option to engage for their lands on specified terms or to quit. It further removed any extant doubts as to the claims under the Dutch grants. Thus passes for good all question of collection of the tenth and in the Straits Settlements Malacca Lands Customary Rights Ordinance (Ord. 9 of 1886 and amended by Ord. 7 of 1901) no mention of the tenth is made. By this Ordinance a permanent, heritable right to land is created which is transferable within limits (exclusive of aliens) and which is subject to certain reservations, the most important being the right of resumption for neglect to cultivate or to pay rent for a period of three years; the power to prohibit certain classes of cultivation, and a claim to demand certain duties such as free service for customary works of public benefit and the simultaneous cultivation of sawah (wet rice) lands. In these duties and reservations are seen the relics of the old customary tenure.

Hitherto the main tract concerned has been Malacca and interest now passes to that greater portion of the Malay Peninsular now known as the Federated Malay States, composed of Perak, Selangor, Negri Sembilan and Pahang, and the Unfederated States, Johore, Kedah, Perlis, Kelantan and Trengganu. Of the Federated States the first three accepted Residents and Advisers in 1874; Pahang followed suit in 1887 and federation was arranged in 1895. By this time a clearer recognition of the basis of customary tenure was attained and the earlier mistakes of Malacca were avoided. The feature of the system which is of greatest interest, is the adaptation to include plantation tenures for which a climatic suitability, particularly for rubber, created a demand. It is unnecessary to follow this development of the land system in detail. The system in the Federated States, which applies to the component States of the Federation and had been largely followed in independent enactments in the various Unfederated States, is based on a recognition of five classes of land:—

(1) town land,
(2) village land (by notification),
(3) country land less than ten acres,
(4) country land greater than ten acres,
(5) foreshore and sea bed.

With the first two and the fourth of these the present articles are not concerned. The distinction between (3) and (4) aims at demarcating the indigenous system, characterized by small holdings, from the plantation system and the rules are framed to meet this distinction. By Enactment 11 of 1911 the different State laws were repealed and a common law introduced. This, with its amendments, has now been replaced by a Land Code (Ordinance 24 of 1926) which incorporates both the earlier enactments relating to titles and those relating to registration. Titles to country land of less than ten acres are established by entry in the *mukim* register, a system of registration based on the Torrens

system; titles to country land greater than ten acres are by lease or grant. Certain rights are reserved such as the right of resumption when there is no heir and on failure to fulfil the conditions of the tenure. Also the right to revise the rent in 1940 and at subsequent intervals of not less than 30 years, a condition reminiscent of the Indian settlement, and the right to specify crops which may be, and may not be, grown. The conditions, in addition to the payment of rent, include the continuous cultivation in a proper manner and, in the case of land of over ten acres, this condition is interpreted as meaning *bona fide* commencement within 12 months, a quarter of the area within five years, a half within ten years and maintenance of the half subsequently. Failure to maintain that half for three consecutive years constitutes default. Transfer is permitted on registration and sub-letting is permitted but if the lease be of more than one year, it must be registered. Accompanying this legislation, and mainly instrumental in its efficient administration, has been the organization of a Survey Department and no land is alienated without a preliminary survey.

Ceylon.

Pre-British Period.

The history of Ceylon follows in broad outline that of Malay. There is the same incursion from India followed in succession by Portuguese, Dutch and, last, British control. The development of a land tenure system also follows parallel lines. By the time the Portuguese obtained a footing in the late sixteenth century a system in many respects very similar to that found in Malay had been established though Reimers (5) detects an allodial system. The dominant feature of the relationship between lord and subject was one of service. The village community was an intricate assemblage of individuals to each of whom a particular service was assigned. In the absence of any pressure on the land, it is the natural relation and only later does service come to be associated with land. The land was, as definitely as in Malay, the property of the ruler who, in true feudal style, assigned to over-lords his claims to particular tracts. In time those rights became defined by custom and extended beyond mere service. Thus was tithe, in the common form of one-tenth, gradually introduced. Concerning the details of these customary rights little is on record before the Portuguese entered into possession of part of the island. With the cession to them of the kingdom of Kotte in 1597 the Portuguese entered upon a very complete settlement of the country and drew up very complete records of the customary rules relating to tenure, which are recorded in their Thombos, or registers of village holdings, and Forals, or registers of over-lords dues. How detailed these registers were, giving even the number of each form of economic tree, yields, &c., the extracts from the few extant registers given by Reimers, well indicate. Through this system of service was established the ruler's monopoly in the more valuable products, particularly cinnamon, at that time collected from the wild tree; to the *chalias* was allotted the service of collecting the bark and these had to supply an assessed quantity. It is of interest to note that even at this early period the practice of destroying any excess was adopted for the dual purpose of keeping up the price, for its disposal to traders constituted the main revenue of the State, and of maintaining the service demand. This is the principle of monopoly adopted by the Dutch later when, in 1770, they introduced the plant into cultivation, a monopoly which they enforced by strict limitation of the quantity grown and by destruction of surplus stocks. The same principle of monopoly was extended by the Dutch to areca nut through which the island's requirements of rice, the local production of which has long been insufficient, were met from Southern India. Neither the Portuguese nor Dutch obtained a footing in the kingdom of Kandy which remained independent till 1815 when it was conquered by the British, and a detailed account of native custom with regard to service and tenures has been given by D'Oyly (6).

His account demonstrates the domination of service over tenure throughout the kingdom. The *Lekam Miti*, or registers, are concerned with persons liable to service though there is this association with land, that lands which properly subject the possessor to regular public services and contributions are low paddy lands which can be cultivated every year, but not (with few exceptions) gardens or high grounds, and abandonment entails freedom from service.

The British Period.

On its conquest by the British, Ceylon passed for a brief period to the East India Company and was administered from Madras. The unfortunate result of this arrangement was the wholesale introduction of the Madras revenue administration in supersession of the customary system of the island. Among the changes introduced were the abolition of all services and the substitution of a tax of one-tenth of the produce in exchange for which an absolute ownership with power to alienate was granted. The replacement of local officials by officers introduced from Malabar to carry out these changes, however, led to insurrection; the entire system broke down and in 1797 the island was transferred to the Crown. With this change a reversion to the Dutch system was made and the Malabar officials were gradually replaced by natives. With power over the whole island consolidated in 1815 after the conquest of the Kandyan kingdom, progress in stabilizing the position with regard to revenue and land has been steady and follows an evolutionary process from the systems maintained by the Dutch. The key to the Dutch system lay in monopoly and service, and these same features appear in the earlier period of British rule of which the subsequent development led to freedom of trade

in agricultural produce and the replacement of service tenure first by a land tax and subsequently by free possession. The early steps in this direction were directed to the stimulation of agricultural production and constituted a complete reversal of the Dutch policy which aimed at discountenancing such production except that which fed their monopolies.

The abolition of service tenures took place more gradually and the question is naturally linked with that of the *quid pro quo* to be demanded in substitution. As has been noted, the first stage consisted of the substitution of a tax on produce similar to that imposed by the East India Company but this tax was soon abolished for all classes of produce except paddy; and land, thus, became freed of all taxation. The reasons which lay behind this departure from local, and oriental, custom are not clear from the documents consulted but it may be surmised that the revenue derived from the sale of land, for which the development of plantations was responsible, produced a sufficient sum to render a produce tax relatively unimportant. The rule forbidding the tenure of land by Europeans was relaxed in 1812 and the taking up of land for plantations, first commenced in 1824, received an impetus from Sir Edward Barnes' (Governor, 1824-31) progressive policy of road development which opened up the interior. The first step in this abolition of service tenures was the Proclamation dated 3rd September, 1801, which applied to the maritime provinces, and this was extended to the whole island by the Order in Council dated 12th April, 1832. In the beginning a produce tax was substituted but in 1818, and more specifically in 1824, all taxes with the exception of that on rice were abolished. In the non-maritime provinces, the old Kandyan kingdom, the progress of abolition was not so rapid. After the rebellion, by Proclamation dated 21st November, 1818, loyal chiefs with their heirs were granted their lands free with certain exceptions when they paid the customary tenth, and chiefs holding office were given the same concession during the tenure of those offices. It was not till 1870 that service tenures in Kandy were definitely settled when, by Ordinance 4 of 1870, commissioners were appointed to settle the terms of conversion to a money payment.

The retention of the tax on rice calls for further remark since it forms an anomalous retention of a customary due abolished in all other cases. It has been referred to by Tennent (7) as a strange inconsistency the evils of which are so obvious that it is difficult to justify the policy which has so long postponed the application of a remedy. These evils lay less in the check the tax placed on cultivation, in which matter it was opposed to the general policy of fostering agriculture, than in the method of its enforcement. That system is described at length by Tennent (8). It consisted of the valuation of the immature crop by Government assessors, by which an estimate of the value was obtained, and each district was then farmed out by public auction, a system which, as Tennent points out, threw wide the door to abuses. As has been noted above, Ceylon had been from early days dependent on imported rice and, concurrent with the tax on production, an import duty of 7*d*. per bushel on rice and 3*d*. per bushel on paddy, equivalent to an impost of 50 per cent. on lowest, and 25 per cent. on highest, quality, was imposed thus taxing the staple food of the masses. In spite of Tennent's condemnation, the tax was not ultimately abolished till 1893 (Ord. 4 of 1893) though it had in the meantime been largely reduced by commutation.

With the removal of all forms of taxation on land, the revenue demand for a detailed record of holdings ceased. But revenue is not the sole justification for such a record; the individual requires security of tenure while Government has an equally strong motive for defining boundaries since, as the direct successor to the native rulers, it claims direct control of all unclaimed land. Claims are based on cultivation and, as in Malay, cultivation is of three kinds, wet rice, gardens, and *chena* or shifting cultivation (Malayan *ladang*). In a sparsely populated country with no tax to give an urge to detailed record, the question of defining rights is not an urgent one. But, with the appreciating value of land arising from the opening up of plantations, the need for some systematic record became more pressing. As in Malay, at once the most difficult, as the most important, question concerned shifting cultivation (*chena*). The matter was first seriously taken in hand in 1840 when an Ordinance (Ord. 12 of 1840) was passed to prevent encroachment on Crown lands. In this Ordinance Crown lands were defined as all cinnamon lands possessed by Government for over 30 years, all forest, waste, unoccupied or uncultivated land and all *chenas*. It also arranged for the granting of certificates of title. A succession of Ordinances followed of which the more important are those of 1891 (Ord. 14 of 1891) and 1927 (Ord. 23 of 1927) dealing with registration of titles. Concurrently a Survey Department was organized and, in conjunction with the Survey and as the result of the development of squatting, special officers were appointed to settle claims relating to forest, waste, *chena* and unoccupied land (Ord. 1 of 1897). Until recently, Crown land was alienated by auction after survey and sold outright but the system proved an encroachment on village lands. Village lands are now demarcated by survey and excluded from alienation for plantations in a manner which recalls the Malayan system. Since 1918 outright sale has, in most cases, been abandoned and a system of leasing adopted. Little has been done to control peasants' holdings though the tendency of the peasant to part with his holding has been partially met by a system of leases on restricted tenure.

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REVIEWS.

THE METHOD OF STATISTICS.

By L. H. C. Tippett, M.Sc. (Lond.). 222 pp. 15s. *Williams and Norgate Ltd.*, London.

The science of Statistics in this country seems to have been subject to two main influences. The biometric school associated with Professor Karl Pearson has developed methods and concepts which form the basis of the whole subject, and in more recent years the needs of biological experimentalists have been met by developments in the theory, due largely to Dr. R. A. Fisher. In "The Method of Statistics" the author has attempted to present a single system of statistics, so that a reader with little previous acquaintance may obtain a good working knowledge and understanding of the methods available.

The first chapters of the book deal in orthodox manner with frequency distributions and constants, and with the theory of errors. In the later chapters, the underlying theme is Fisher's Analysis of Variance. In outlining the theory underlying the methods described, mathematical proofs are given where they are easy, otherwise results alone are stated. The necessary mathematical attainments of readers need therefore be slight. The literature has been largely drawn on for explanatory examples. The author's system of nomenclature is not always identical with that adopted by Fisher; "t" for example, is used to designate "degrees of freedom", and should not be confused with Fisher's $t = d \div \frac{s}{\sqrt{N}}$. There appears to be some confusion in the early part of the book in the use of the terms "sample" and "population". No distinction seems to be drawn between standard deviation and standard error. It might have been advantageous to avoid the use of semi-colons after formulae or numerical expressions appearing in the centre of the page.

P. E. T.

THE WASTE PRODUCTS OF AGRICULTURE.

Howard & Wad. *Humphrey Milford*, 1931, pp. 165+xiv, price 7s. 6d.

The real purpose of this book is to describe the system of manufacturing compost which Mr. Howard and his staff have worked out at the Institute of Plant Industry, Indore, Central India. The subject is introduced by a general discussion of the rôle that organic matter plays in keeping up soil fertility, with an excellent chapter, which is recommended to the attention of Colonial Agricultural Officers, emphasising the difference between the age-old self-contained peasant farming of the East, and the newer more wasteful agriculture of the Occident, which depends so largely on imported fertility in the shape of manures.

The description of the way in which the author claims to have solved the problem at Indore follows, and is extremely detailed. This is useful, because it is matter of common experience, that satisfactory decomposition in the compost heap is a matter of careful adjustment of moisture and aeration, and methods have to be continually varied according to the class of material and the time of the year. Photographs are given showing the appearance of the heap at different stages of decomposition, and line drawings of the implements used, including even that familiar object of the East, the kerosene tin.

A number of appendices help to swell the book, and are of varying interest.

The senior author has 26 years of experience of crop production in India, and writes with authority when he calls attention to this very important question of the maintenance of fertility in peasant holdings in the Tropics, a problem which has been partially solved in India, as is shown in the present little work, and in China, as was shown by King, in his "Farmers of Forty Centuries". In spite of its padding, it is distinctly a book to get.

R. C. W.

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FOREST TREES AND TIMBERS OF THE BRITISH EMPIRE.

1. Some East African Coniferae and Leguminosae, by L. Chalk, J. Burtt Davy, and H. E. Desch. *Clarendon Press*, Oxford. Pages 68, price 5s.

The exploration of hitherto untouched forests of tropical countries of the Empire is proving that almost unlimited wealth and revenue can be gained by a proper exploitation of their timbers. The first essential for this new industry is a good Forestry Department whose primary task is to map the workable areas, identify the trees, and to explore rejuvenation and the commercial possibilities of the different timbers there.

This first book, dealing with a few of the East African trees, promises well for the remainder of the series and will prove invaluable, not only to the timber specialist, but also to the botanist.

F. J. P.

SUGAR NOTES.

Compiled by the College Department of Sugar Technology.

The Cultivation of Ratoons in Hawaii. *W. W. G. Moir.*

The sugar industry of Hawaii is noted for the success of its planters in producing abundant ratoon crops year after year. The author summarizes the principles by which this result is achieved. As a rule, in preparing for a plant crop, the soil is deeply stirred without bringing sterile subsoil to the surface. On irrigated plantations all water is withheld for six weeks to several months in order to force the cane to ripen. In preparing for the next ratoon crop, the first principle followed on irrigated areas is to get water on the stubble as soon as possible, in order that no time may be lost in reviving the stools after long exposure to dry conditions. The second principle is to till the field properly for the following crop; that is, to subsoil the earth next to the cane and to use the loosened soil to build up the furrow bank ("kuakua") in the middle. In all succeeding cultivations, the object is to preserve the "kuakua" so that the irrigation water will flow directly past the cane stools; when the "kuakua" has been broken down the field must be replanted. The third principle is to manure early with nitrogen and phosphate (when phosphate is required), and to give a second manuring a little later when only nitrogen and potash are needed. How much of these manurial materials is required is known for practically every area through soil analyses and field experiments. The fourth principle is to perform every operation on time; that is, to irrigate, manure and cultivate as soon as these operations are required. The fifth principle is to harvest the cane at the proper time and in the proper manner. Valuable time should not be lost after the cane has reached the economic maximum of growth. It should be cleared away for the next crop (15 to 18 months in many cases). The sixth principle is to take measures for disease prevention, and the seventh, and most important, is to make a choice of the best possible cane varieties for planting.

On unirrigated areas the principles followed are somewhat different. Here the first principle is to remove the trash and debris from the stubble as soon as possible. If tractor cultivation is practiced, the trash must be burned or chopped, so that it will not interfere with the cultivating implements. Where no cultivation is done, the trash still must be raked off the stubble. The second principle is to loosen the soil near the stubble as soon as possible, before any great number of new roots can be formed. The remaining principles are the same as for irrigated areas. The greatest single factor of all in raising ratoon crops is the proper timing of operations.—(*Facts about Sugar*, Vol. XXVII, No. 6, June, 1932.)

The Scientific Control of Pan Boiling. S. J. Saint.

With the aid of the Zeiss factory refractometer and appropriate tables, the graining and subsequent boiling of syrups in the vacuum pan can be controlled with precision by persons with no experience in the empirical methods of pan boiling. Ordinarily, the sugar boiler forms the grain by the "waiting" method, which means that the syrup is concentrated until crystals appear spontaneously. But this is now to be regarded as a poor method; in order to obtain a perfectly regular grain it is necessary to induce the syrup to deposit the requisite number of crystals at one and the same time, and to attain this result it is necessary that a high supersaturation be suddenly formed in the syrup. This condition is most nearly fulfilled by the "shock" method, in which crystallization is induced by suddenly raising the vacuum.

In order to draw up tables for the use of the sugar boiler it is convenient to equate the variables concerned by means of the formula:

$$W = \frac{100 \quad R}{C_1 . C_2 . Lt. R}$$

in which R is the purity of the syrup, C_1 the saturation co-efficient at purity R, C_2 the co-efficient of supersaturation, W the water content, Lt. the solubility of sucrose at temperature T. When the purity and temperature of a cane syrup are known, then either the saturation or the percentage of dry matter may be calculated if one of these is known. By determining the apparent coefficient of supersaturation, calculated on optical purity and refractometric dry matter, the basis is given for an accurate control of the boiling process through use of the pan refractometer. Thus, in the 3-strike system the optimum coefficient of supersaturation for the mother liquor is about 1.15 for "A" strikes, 1.2 for "B" strikes, and for "C" strikes 1.2, up to about half the striking volume, which is gradually raised to 1.35 at 80 per cent. of the striking volume, and to 1.5 at 100 per cent. In drawing up tables for shock graining, graphs may be prepared showing the relation between vacuum and concentrations at the desired supersaturations. These tables may then be issued to the pan boiler as instructions for operating the vacuum pan.—(*Facts about Sugar*, Vol. XXVII, No. 6, June 1932.)

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Manganese as an Essential Element in Cane Growth. *L. E. Davis.*

By experiments carried out in field and laboratory with the cane variety H. 109 the author finds* that the disease of sugar-cane known in Hawaii as Pahala blight is evidently a physiological disease due to manganese deficiency. Manganese is stimulating to sugar-cane in relatively large concentrations (4.5 to 6.0 parts per million) provided other nutrients are present in sufficient amounts.—(*Facts about Sugar*, Vol. XXVII, No. 8, August, 1932.)

*(*Hawaiian Planters' Record*, Vol. XXXV, No. 4, pp. 393-400.)

CHEMICAL NOTES.

Compiled by the College Department of Chemistry and Soil Science.

Chemically Combating Insect Pests of Foodstuffs.

In his warfare against insects, man uses biological means such as insect predators and parasites, physical means such as traps, heat, cold, electricity and ultra-violet rays, and chemical means or insect poisons. These insect poisons or insecticides are usually classified as fumigants (toxic gases or vapours), contact poisons, and stomach poisons.

Fumigants are the ideal insecticides for closed spaces, since the gas expands and penetrates every crevice. For the destruction of roaches on ships, weevils in wheat, beetles in flour, and insects infesting dried fruits, nuts, and other stored foodstuffs, a fumigant is the proper insecticide to apply. Of the various fumigants used, carbon disulphide is very effective, but its ready inflammability limits its use. Hydrogen cyanide (prussic acid) is highly toxic, both to man and to insects, and it tends to remain in the material for some time. For example, cocoa retained 192 parts per million at the end of one day, and 31 parts per million at the end of thirty days after fumigation. Ethyl formate is an effective fumigant for destroying insects in dried fruits, and has been used on a large scale in the treatment of raisins. Ethylene dichloride and propylene dichloride are now commercially available, and are effective grain fumigants, and their inflammability may be removed by adding a small proportion of carbon tetrachloride. But the ideal fumigant for foodstuffs is ethylene oxide. It is more toxic than prussic acid to some insects and is much less toxic to man; it is odourless and does not injure the taste or appearance of food products. Even tobacco may be safely fumigated in this way. A combination of ethylene oxide and solid carbon dioxide ("Dry-Ice") is very effective in the fumigation of wheat or grain elevators.

Nicotine is one of the principal agricultural contact insecticides and is effective in ridding fowls of lice if painted on the roosts. The pyrethrins of pyrethrum flowers are among the most potent insecticides known and are especially valuable because they are non-poisonous to man and domestic animals when taken by mouth. A new insecticide called Rotenone has given great promise in laboratory and field tests. It occurs in the East Indian vine (derris) and in the South American shrub cubé, is non-toxic to man, and is very effective in the treatment of external parasites of domestic animals.

Arsenic compounds are still the principal poisons used against chewing insects. Such compounds are Paris green, zinc arsenite, magnesium arsenate and manganese arsenate, but the removal of the toxic residue left on the fruit is a source of great expense to the growers. Barium fluosilicate is an effective substitute, but the toxicity of this compound to man has not been fully investigated.—(Roark. *Ind. and Engin. Chem.*, Vol. XXIV, No. 6, 1932, p. 646.)

The Nitrogenous Nutrition of Grasses.

(*a*) *General and Soil Factors*, by W. G. Eggleton, A. H. Lewis, and H. J. Page.

In grassland soils the evidence so far available indicates that the up-grade and down-grade processes of the nitrogen cycle are no different in nature from those in arable soils but the level of intensity of these processes is on a much higher plane. Owing to the different conditions in grassland soils—especially the plentiful supply of organic matter derived from the dense mass of roots—the population of micro-organisms is greater, and the fluctuations in their numbers are rapid and intense. The balance of the opposing up-grade and down-grade processes, which determines the nitrogen status of the soil, is weighted towards the up-grade side in grassland soil: low available nitrogen, more ammonia than nitrate, and high organic nitrogen; whilst in arable soils it is weighted in the opposite direction. At lower soil temperatures, the locking up of inorganic nitrogen, through its assimilation by micro-organisms, is greater, and thus the competition between the herbage plants and the soil organisms, always an intense one, is even more acute. Grassland herbage is thus peculiarly responsive to dressings of inorganic nitrogenous fertilizers, and especially so in the early spring when soil temperatures are low.

* * *

(*b*) *The Influence of Fertilizers on the Growth and Composition of Grasses*, by G. E. Blackman, A. W. Greenhill, and J. Procter.

In pasture land the two most important factors in controlling growth are the available nitrogen and water supply in the soil. Under conditions of natural rainfall, the addition of nitrogenous fertilizers not only largely increases the yield and crude protein production per acre, but also lengthens the grazing season by accelerating growth in the spring and prolonging it in the autumn. Nitrogenous fertilizers in addition can bring about changes in the chemical composition, increasing both the nitrogen and phosphorus content. The magnitude of these changes is correlated both with the intensity of manuring and frequency of defoliation. Under the temperature limiting-conditions of spring, the addition of nitrogen compounds does not bring about growth earlier in the season than on the control, but accelerates growth as soon as the four inch soil temperature reaches 43° F. This acceleration is due to the absorption and protein synthesis of the added nitrogen by the roots, which can take place at as low a temperature as 35° F., in contrast to the control where there is a lack of available nitrogen when growth starts, due to the immobilization of the soil nitrogen under low temperature conditions. As a result, no nitrogen absorption takes place on the control until the temperature rises above 43° F., and the "locked up" nitrogen is released.—(*Chemistry and Industry*, Vol. LI, No. 25, 17th June, 1932.)

TREND OF THE MARKETS.

[*The notes below are based principally upon running charts of the prices of the basic grades and upon general statistical information gleaned from contemporary publications and cablegrams and are intended to be a record of movements. An attempt is made, where possible, to indicate the market outlook at the time of going to press, but no responsibility for the accuracy and subsequent truth of such observations is assumed. Unless otherwise stated the prices quoted are spot, London.*]

SUGAR :—Prices on the Home Market have ranged as follows (c.i.f. per cwt.)

	Foreign.		*Preferential.*	
	s.	*d.*	*s.*	*d.*
28th July ..	6	3	10	10½
4th Aug. ..	6	3	—	
11th Aug. ..	6	6¾	11	3
18th Aug. ..	6	6	11	3¾
25th Aug. ..	6	5¼	11	2¼
1st Sept. ..	6	4½	11	1½
8th Sept. ..	6	3	11	0
(*10th Sept.*, 1931)	5	7½	9	4½

The market has been quiet and lacking in any feature of interest. On the whole the weather has been favourable in most Continental Beet producing countries, and the condition of crops generally good. In Central Europe and Russia the conditions are reported as mediocre to poor. The improvement in sugar conditions generally is demonstrated by the comparative firmness with which sugars are held in the absence of buying activity.

* * *

COCOA.—Although stocks of cocoa are still high in New York supplies from primary points are turning out to be much less than expected with the result that the statistical position will continue to improve. On this account prices are doing likewise and in the last few days price for Trinidad Cocoa in New York has shown an advance of 5 cents to 8 cents. On the other hand the main Accra Crop should be appearing next month and much will depend as to how this will be marketed. With conditions as they are, however, it is likely the inclination will be to hold for present, if not better prices. On the whole, therefore it is felt that the market has reached bottom and has now definitely taken on a turn for the better. Price for the new main Accra crop has been quoted at 28*s.* 6*d.* c.i.f. while in Trinidad $7.50 a fanega is paid.—(*By courtesy of the Cocoa Planters' Association of Trinidad Ltd.*)

* * *

TEA.—Prices fell off during the latter part of June but improved during July and have maintained this recovery during August. Averages on 17th August, included Ceylon 8.07*d.*, Indian 7.16*d.*, and Java 4.71*d.*, respectively, per lb. Stocks amounted to 183,947,316 lb. compared with 198,062,561 lb. a year ago. Imports from 1st January to 31st July totalled 231,007,310 lb. against 222,412,292 lb. last year. Appreciable increases in sales have taken place and prices have been fairly well maintained. New season's arrivals up to the end of July were disappointing in quality but an improvement is now anticipated. (*Times Trade & Engin. Supplement*, August, 1932.)

* * *

RUBBER.—Quotations for Plantation Sheet have ranged as follows :—

	d.
27th July	$2\frac{1}{32}$
3rd Aug.	$2\frac{1}{16}$
10th Aug.	$2\frac{15}{16}$
17th Aug.	$2\frac{15}{32}$
24th Aug.	$2\frac{15}{32}$
31st Aug.	$2\frac{13}{16}$
7th Sept.	3
(*9th Sept.*, 1931)	$2\frac{3}{8}$

Prices have remained fairly firm at the rather higher price recorded last month. Keener interest has been taken in rubber in the United States recently, influenced, presumably, by the general improvement in world sentiment. Some journals have advocated the merits of rubber as a lock-up for substantial capital appreciation in the future. Recent shipments have been heavy and existing world stocks are a grave obstacle to any immediate and substantial recovery in prices.

* * *

COTTON.—The following are the official spot prices in pence per lb. of the Liverpool Cotton Association.

	American Mid.	*Egyptian F.G.F. Sakel.*
29th July ..	4.67	7.10
5th Aug. ..	4.69	7.15
12th Aug. ..	5.51	7.80
19th Aug. ..	5.71	8.00
26th Aug. ..	6.45	—
2nd Sept. ..	6.57	—
9th Sept. ..	6.38	—
(*11th Sept.*, 1931)..	3.70	5.60

Prices have risen substantially, a sensational rise being recorded on 9th August. The causes are attributed to a feeling of greater confidence, especially in America, and the continued unfavourable weather in the Cotton Belt. The Bureau report estimates a crop of 11,306,000 bales whereas a crop of about 12,250,000 bales had been expected. This announcement stimulated buying of every description. Weevil is spread fairly well over the Belt, particularly in the Delta. The recent showery weather has favoured the pest. There is a feeling that the determined bullishness in the United States owes its origin to a desire to present a favourable state of affairs in view of the approaching Presidential election. It remains to be seen how far America can maintain higher prices without a definite improvement in the rest of the world.

* * *

COFFEE.—Fine Jamaican coffee has steadily maintained its level but other growths have fallen in price. Stocks in bond are 360,000 cwt. against 332,000 cwt. a year ago. Prices on 17th August, included 205*s.* for Jamaica, 105*s.* for Costa Rica. 75*s.* for Kenya Good, and 65*s.* for Brazil Santos. (*Times Trade & Engin. Supplement*, August, 1932.)